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3763

Title: **SKIN-GRIPPER**

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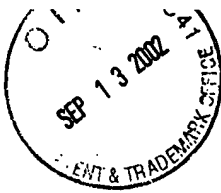
**William H. Dippert, Esq.**  
c/o Reed Smith LLP  
599 Lexington Avenue, 29th Floor  
New York, NY 10022-7650  
Tel: (212) 521-5400

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## PCT REQUEST

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158/00653

0	For receiving Office use only	
0-1	International Application No.	PCT/IL 9 9 / 0 0 5 8 4
0-2	International Filing Date	02 NOVEMBER 1999 (02.11.99)
0-3	Name of receiving Office and "PCT International Application"	ISRAEL PATENT OFFICE PCT International Application
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.84 (updated 01.07.1999)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Israel Patent Office (RO/IL)
0-7	Applicant's or agent's file reference	158/00653
I	Title of invention	SKIN-GRIPPER
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	WIZCARE LTD.
II-5	Address:	P.O. BOX 2054 39120 TIRAT CARMEL Israel
II-6	State of nationality	IL
II-7	State of residence	IL
II-8	Telephone No.	+972 (4) 857 8006
II-9	Facsimile No.	+972 (4) 851 4856
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	INGMAN, Dov
III-1-5	Address:	3/55 HAIM HAZAZ STREET 34980 HAIFA Israel
III-1-6	State of nationality	IL
III-1-7	State of residence	IL

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IV-1	<b>Agent or common representative; or address for correspondence</b> The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	<b>agent</b>
IV-1-1	Name (LAST, First)	FENSTER, Paul
IV-1-2	Address:	FENSTER & COMPANY PATENT ATTORNEYS, LTD. P. O. BOX 10256 49002 PETACH TIKVA Israel
IV-1-3	Telephone No.	+972 (3) 921 5380
IV-1-4	Facsimile No.	+972 (3) 921 5383
IV-1-5	e-mail	fensterco@ibm.net
IV-2	<b>Additional agent(s)</b>	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	FENSTER, Maier; WEISS, Phillip; ENTIS, Allan
V	<b>Designation of States</b>	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW SD SL SZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AL AM AT AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW
V-3	National Patent (States which have become party to the PCT after the issuance of this version of EASY)	MA MOROCCO

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V-5	<b>Precautionary Designation Statement</b> In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	<b>Exclusion(s) from precautionary designations</b>	NONE
VI	<b>Priority claim</b>	NONE
VII-1	<b>International Searching Authority Chosen</b>	European Patent Office (EPO) (ISA/EP)
VIII	<b>Check list</b>	number of sheets      electronic file(s) attached
VIII-1	Request	4      -
VIII-2	Description	31      -
VIII-3	Claims	8      -
VIII-4	Abstract	1      abstract_653.txt
VIII-5	Drawings	17      -
VIII-7	TOTAL	61
	<b>Accompanying items</b>	paper document(s) attached      electronic file(s) attached
VIII-8	Fee calculation sheet	✓      -
VIII-10	Copy of general power of attorney	✓      -
VIII-16	PCT-EASY diskette	-      diskette
VIII-18	Figure of the drawings which should accompany the abstract	2
VIII-19	Language of filing of the international application	English
IX-1	Signature of applicant or agent	
IX-1-1	Name (LAST, First)	ENTIS, Allan

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10-2	Drawings:	
10-2-1	Received	✓
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	✓

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11-1	Date of receipt of the record copy by the International Bureau	
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**PCT (ANNEX - FEE CALCULATION SHEET)**

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(This sheet is not part of and does not count as a sheet of the international application)

0 0-1	For receiving Office use only International Application No.	PCT/IL 99 / 00584		
0-2	Date stamp of the receiving Office	02 NOVEMBER 1999 (02.11.99)		
0-4 0-4-1	Form - PCT/RO/101 (Annex) PCT Fee Calculation Sheet Prepared using	PCT-EASY Version 2.84 (updated 01.07.1999)		
0-9	Applicant's or agent's file reference	158/00653		
2	Applicant	WIZCARE LTD., et al.		
12	Calculation of prescribed fees	fee amount/multiplier	total amounts (USD)	total amounts (ILS)
12-1	Transmittal fee T	⇒		426
12-2	Search fee S	⇒	1,002	
12-3	International fee Basic fee (first 30 sheets) b1	455 USD		
12-4	Remaining sheets	31		
12-5	Additional amount (X)	10 USD		
12-6	Total additional amount b2	310 USD		
12-7	b1 + b2 = B	765 USD		
12-8	Designation fees Number of designations contained in international application	83		
12-9	Number of designation fees payable (maximum 10)	10		
12-10	Amount of designation fee (X)	105 USD		
12-11	Total designation fees D	0 USD		
12-12	PCT-EASY fee reduction R	-140 USD		
12-13	Total International fee (B+D-R) I	⇒	625	
12-17	TOTAL FEES PAYABLE (T+S+I+P)	⇒	1,627	426
12-18	Designation fees are not paid at this time	✓		
12-19	Mode of payment	other: Please bill us.		

**VALIDATION LOG AND REMARKS**

13-2-2	Validation messages States	Yellow! Additional national designation added: Obtain updated maintenance tables rather than using this field.
13-2-4	Validation messages Priority	Green? No priority of an earlier application has been claimed. Please verify
13-2-6	Validation messages Contents	Green? Reference number for attached copy of general power of attorney not indicated.

**PCT (ANNEX - FEE CALCULATION SHEET)**

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13-2-7	Validation messages Fees	Green? Please verify that modified fee amounts are correct.
		Green? Designation Fees not paid: see Help for payment time limits.



## **SKIN-GRIPPER**

### **FIELD OF THE INVENTION**

The invention relates to apparatus and methods for attracting and holding fast areas of skin using electric fields and for using such apparatus and methods for therapeutic and cosmetic treatment of the skin and for attaching jewelry, clothes and other objects to the skin.

### **BACKGROUND OF THE INVENTION**

There are very few methods for grasping and holding the skin or for attaching and fixing objects and decorations directly to the skin. Skin is generally grasped and held by clamping or pinching it. Objects to be attached to the skin are either tied or strapped to a body part or attached to the skin with a glue, adhesive or paste. In some cases the skin is pierced to attach an object, such as an earring, to the skin.

It would be advantageous to have a method of attaching bandages, sensors, therapeutic devices, and decorative and protective objects to the skin by simply placing them in contact with the skin without the need to pierce or deform the skin or use a glue, adhesive or gel.

### **SUMMARY OF THE INVENTION**

An aspect of some preferred embodiments of the present invention relates to providing an apparatus, hereinafter referred to as a "skin-gripper", that comprises a surface, which when placed in contact with a region of a person's skin generates strong forces that hold the region to the surface. The surface of a skin-gripper that attracts and holds the skin is hereinafter referred to as a "gripping surface".

In a preferred embodiment of the present invention, a skin-gripper comprises a conducting layer, which comprises at least one conductor having a surface covered with a thin insulating dielectric layer, and an electric power supply for electrifying the conductor. The power supply is grounded to the skin so that when the power supply electrifies the at least one conductor, a potential difference is generated between the at least one conductor and the skin. Preferably, the conducting layer is formed or bonded to an appropriate insulating substrate. The dielectric layer is formed from a material that has a relatively high dielectric constant and high breakdown voltage.

When the conductor is held so that the dielectric layer is contiguous with a region of the skin, the power supply is operated to provide a potential difference between the skin and the conductor. The skin, because of electrolytes in the skin and in tissue below the skin, acts as a conductor. Therefore, as a result of the potential difference, substantially equal and opposite surface charge densities are generated on the surface of the at least one conductor and the

region of skin to which the conductor is pressed. The region of skin is thereby strongly attracted to and held fast to the dielectric layer on the conductor surface. The surface of the dielectric layer to which the skin is held fast is a gripping surface of the skin-gripper.

5 The at least one conductor, the skin to which it is attracted and the thin dielectric insulating layer between them operate as a capacitor having a dielectric layer between the capacitor's plates. The force that attracts and holds the skin to the conductor may therefore be estimated from the usual capacitor formulae. For appropriate choices of potential difference between the conducting layer and skin, thickness and dielectric constant of the insulating layer, in accordance with a preferred embodiment of the present invention, the force that attracts the  
10 region of skin to the surface of the electrode attains values between about 10 – 100 Newtons per cm<sup>2</sup> of conductor surface. This attractive force has the same effect in holding the skin and conductor together as if the skin and conductor were pressed together with a pressure of between about 1 - 10 atmospheres.

In order for the attractive force to attain the magnitudes noted above, the surface of the  
15 dielectric, *i.e.* the gripping surface, must be in close contact with the skin to which it is pressed. In some cases, body hair may interfere with the required close contact between a gripping surface of a skin gripper and skin to which the skin gripper is placed in contact. To assure appropriate close contact, in some preferred embodiments of the present invention, the dielectric layer of the skin gripper is formed sufficiently flexible so that the gripping surface  
20 bends, or "molds itself", around body hair and contacts regions of bare skin between body hair follicles. For some applications, to assure appropriate contact, body hair on a region of skin is shaved before the gripping surface of a skin gripper is placed in contact with region of skin. In accordance with some preferred embodiments of the present invention a skin gripper is formed so that its gripping surface is in the shape of a comb that has a plurality of coplanar flexible  
25 closely spaced like teeth. To place the skin gripper in close contact with the skin, the plane of the comb like teeth is placed flush with the skin, *i.e.* with the teeth parallel to the skin, and "threaded" between the body hair.

An aspect of some preferred embodiments of the present invention relates to providing a bandage, hereinafter referred to as an "electro-patch bandage", for protecting skin wounds  
30 that is held in place over the wound by a skin-gripper. The electro-patch bandage does not require adhesive to remain in place over the wound. In addition it provides an electrostatic field that is beneficial to the healing process of the wound.

An electro-patch bandage, in accordance with a preferred embodiment of the present invention, preferably comprises a flexible skin-gripper. Preferably, the skin-gripper comprises a flexible insulating substrate to which a conducting layer having at least one thin pliable conductor is bonded. A flexible layer of dielectric material covers the conducting layer to form the gripping surface. An appropriate power supply electrifies the at least one conductor in the conducting layer.

When the electro-patch bandage is placed to cover a wound on a person's skin, the power supply electrifies the at least one conductor to generate a potential difference, hereinafter referred to as a "gripping voltage" between the at least one conductor and the skin. The magnitude of the gripping voltage is such that the bandage is firmly held in place over the wound by the force with which the gripping surface attracts the skin. Furthermore, as a result of the force of attraction and the flexibility of the gripping surface, the electro-patch bandage conforms itself to the shape of the body in the region of the wound and seals the region of the wound against ingress of contaminants from the environment.

In some electro-patch bandages, in accordance with preferred embodiments of the present invention the dielectric is designed to break down at appropriate gripping voltages to enable small micro-currents of electricity to flow between the conducting layer of the skin-gripper and the skin in contact with the bandages gripping surface. The micro-currents are beneficial for skin health and have an analgesic effect.

In some preferred embodiments of the present invention an electro-patch bandage comprises a heating element that heats the region of skin in contact with the electro-patch bandage. In accordance with some preferred embodiments of the present invention an electro-patch bandage incorporates ultrasound transducers for radiating acoustic waves into tissue in the region of a wound protected by the bandage.

In some preferred embodiments of the present invention, the electro-patch bandage is perforated with a plurality of micro-holes formed in the material of the bandage using methods known in the art so that a wound and skin covered with the electro-patch bandage "can breathe". Preferably, inside surfaces of the micro-holes are coated with a thin layer of insulating material. The insulating material completely covers the walls of the holes and is bonded to both the material of the dielectric layer and the material of the insulating substrate of the electro-patch bandage. This prevents sweat from short circuiting the conducting layer of the electro-patch bandage to skin to which the electro-patch bandage is applied. The insulating layer may be applied to the inside surfaces of the micro-holes using various methods known in

the art. For example, the insulator can be applied to the surfaces of the micro-holes in a dipping or spraying process that is used to form the dielectric layer and/or the insulating substrate

In some preferred embodiments of the present invention the power supply is small and light enough to be mounted to or integrated with the layers forming the gripping surface. In other preferred embodiments of the present invention the power supply is separate from the layers and electrically connected to the at least one conductor in the conducting layer using appropriate conducting wires.

According to an aspect of some preferred embodiments of the present invention, the at least one conductor comprises a plurality of conductors. The conductors are preferably arranged in an array on the insulating substrate and electrified to provide an electric field having substantial components parallel to the surface of the skin to which the electro-patch bandage is applied. Electric fields parallel to the skin tend to promote migration of epidermal cells, which promotes closing of wounds. To provide such a field, in accordance with a preferred embodiment of the present invention, adjacent conductors in the array are charged to opposite polarity by the power supply.

According to an aspect of some preferred embodiments of the present invention a skin-gripper, in accordance with a preferred embodiment of the present invention, is used to provide a device for perfusing a medication into the body through the skin. The medication, in the form of a paste or gel, is preferably applied in a thin layer to the gripping surface of the skin-gripper. When the skin-gripper is placed on the skin and "electrified", the medication is squeezed between the skin and the gripping surface and perfused through the skin into the body by the force with which the skin-gripper attracts the skin. If the medication comprises charged particles, such as charged colloidal particles or molecules to be delivered to the body, perfusion is enhanced by electrophoresis resulting from the electric field between the gripping surface and the skin. The rate at which the medication perfuses into the body is controlled by the area of the gripping surface, the magnitude of the force of attraction between the gripping surface and the skin and the length of time that the skin-gripper is in place on the skin. An aspect of some preferred embodiments of the present invention relates to providing apparatus, hereinafter referred to as a "massager", that comprises a skin-gripper for therapeutic mechanical manipulation and massaging of a person's skin.

According to a preferred embodiment of the present invention, a massager comprises a skin-gripper having a shaped gripping surface suitable for massaging the skin. To massage a person's skin, an operator of the massager electrifies the skin-gripper and holds it so that its

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gripping surface attaches firmly to a region of skin. The operator manipulates the skin-gripper to stretch, pull and massage the region of skin and underlying tissue. Various different shapes for the gripping surface, in accordance with preferred embodiments of the present invention, are possible and advantageous. For example, the gripping surface may be planar or curved or  
5 have a corrugated shape.

In some massagers, in accordance with preferred embodiments of the present invention, the dielectric is designed to break down at appropriate gripping voltages to enable small micro-currents of electricity to flow between the conducting layer of the skin-gripper and the skin in contact with the gripping surface.

10 An aspect of some preferred embodiments of the present invention relates to providing a massager, hereinafter referred to as a "stretch massager", comprising a skin-gripper that has an elastically stretchable gripping surface.

In some preferred embodiments of the present invention, the skin-gripper is formed from a conducting layer having a preferably dense array of preferably small thin conductors  
15 that are laminated or otherwise bonded to an elastically stretchable insulating substrate using methods known in the art. A thin elastically stretchable dielectric layer having appropriate dielectric constant and/or breakdown voltage covers the conducting layer. A power supply is electrically connected to each conductor using methods known in the art so that when the skin-gripper is stretched, proper electrical contact is maintained between the power supply and each  
20 of the conductors in the array.

Stretch massagers are used, in accordance with preferred embodiments of the present invention, for exercising and stimulating skin in order to tone the skin and ameliorate wrinkles. To operate a stretch massager, in accordance with a preferred embodiment of the present invention, the gripping surface of the stretch massager is positioned on a person's skin and  
25 electrified to an appropriate gripping voltage. Areas of skin on edges of wrinkles in the skin contact the gripping surface and are held fast to it by forces of attraction between the skin and the gripping surface. Areas of skin in furrows between edges of wrinkles are displaced from the gripping surface and are not held by the gripping surface. However, when the gripping surface is stretched, edges of wrinkles held by the gripping surface are pulled away from each other.  
30 Wrinkles are flattened out and skin areas in furrows of the flattened wrinkles come into contact with the gripping surface and are thereafter held fast to the gripping surface. Repeated cycling of the gripping surface between stretched and non-stretched states massages the skin and is beneficial for the removal of wrinkles and for improving skin tone.

Whereas stretch massagers, in accordance with preferred embodiments of the present invention are used to flatten and "iron" out wrinkles, other massagers, in accordance with preferred embodiment of the present invention are also used to ameliorate wrinkling. For example, by pressing a gripping surface of a massager, in accordance with a preferred  
5 embodiment of the present invention, to a wrinkled area of skin with sufficient pressure, some wrinkles will be pressed flat and held flat to the gripping surface. When the massager is moved to massage the area of skin, the massaging and flattening of the wrinkles is beneficial for the removal of the wrinkles.

10 An aspect of some preferred embodiments of the present invention relates to providing a method and apparatus that use magnetic fields for treating and ameliorating wrinkles.

In a preferred embodiment of the present invention a thin pliable magnetized foil is stuck, using an appropriate adhesive known in the art, to a region of skin having wrinkles. The foil is "kneaded" to the skin. The thickness of the foil and its Young's modulus are determined so that the pliability of the foil is such that when the foil is kneaded to the skin, the foil molds  
15 to wrinkles in the skin and sticks to skin in furrows of the wrinkles. After the foil is stuck and kneaded to the skin a relatively thick layer of preferably pliable magnetic material is pressed to the foil. Although preferably pliable, the thick layer is substantially less pliable than the thin layer and does not mold itself to furrows of wrinkles on the skin. Attractive magnetic forces between the foil and the thick layer flatten the foil and the wrinkles to the thick layer. The thick  
20 layer and the foil are left in place for a convenient period of time, such as the duration of an afternoon nap or of a mudpack application in a beauty parlor. The treatment is repeated periodically.

Whereas apparatus and methods in accordance with preferred embodiments of the present invention have been described as being used for, among other applications, treating  
25 wrinkles, it should be noted that such apparatus and methods are useable for treating "mechanical" skin blemishes other than wrinkles. They may be used, for example, to treat and reduce scarring from wounds and acne.

An aspect of some preferred embodiments of the present invention relates to providing a massager, hereinafter referred to as a "pattern massager" that massages a region of a patient's  
30 skin by applying attraction forces to the skin in different temporal and spatial patterns.

In some preferred embodiments of the present invention, a pattern massager comprises a skin-gripper that has a flexible gripping surface provided with a plurality of conductors that are electrified independently of each other by an appropriate power supply and switching

circuitry. To massage a region of a patient's skin, the gripping surface is placed in contact with the region of skin and voltage differences are applied between conductors in the gripping surface and the skin in different spatial and temporal patterns. The different temporal and spatial voltage patterns generate different patterns of attractive forces between the gripping surface and the skin that travel over the skin to massage and manipulate the skin.

An aspect of some preferred embodiments of the present invention relates to providing massagers, hereinafter referred to as "motile massagers" that are capable of independently moving over a person's skin.

According to some preferred embodiments of the present invention a motile massager comprises a skin-gripper having a circularly cylindrical gripping surface. Preferably, the gripping surface is formed by adhering or forming a preferably dense array of narrow rectangular strip conductors on a cylindrical insulating substrate surface. The strip conductors are parallel to each other and to the axis of the substrate cylinder and preferably, run the length of the cylinder. Preferably, all the strip conductors have a same width. An appropriate dielectric layer covers the strip conductors. The motile massager comprises a power supply and switching circuit that can preferably electrify each of the strip conductors independently of each other.

When the motile massager is placed on a person's skin only a relatively narrow region of its cylindrical gripping surface (*i.e.* a strip of its surface parallel to the axis of the gripping surface) contacts the skin. At any one time, only a relatively small group of strip conductors that are located opposite the region of skin that is in contact with the gripping surface are electrified by the power supply to grip the skin and hold the motile massager to the skin. The group of electrified strip conductors is hereinafter referred to as a "gripping group". The power supply and switching circuit sequentially electrify different strip conductors to shift the position of the gripping group and thereby cause the gripping body to roll over the skin. As the motile massager rolls along the skin it exerts attractive forces on the skin that massage the skin and increase blood flow to the skin.

To understand how the gripping surface is made to roll, let the extreme electrified strip-conductors that bound a gripping group be referred to as a first and last strip conductor. If the last strip conductor of a gripping group is grounded and the non-electrified strip conductor adjacent to the first strip conductor electrified, then the gripping surface will roll a short distance in the direction of the first electrode. If the power supply and switching circuit are controlled to repeatedly ground the last electrode and electrify the non-electrified strip

electrode adjacent to the first electrode of a gripping group, the motile massager will roll over the person's skin in the direction of the first electrode.

Other geometries for motile massagers that stick to and roll or crawl along the skin, in accordance with a preferred embodiment of the present invention, are possible and will occur to persons of the art. For example a cylindrical gripping surface might be defined by a directrix that is an equilateral polygon or a motile massager might comprise more than one cylindrical gripping surface.

An aspect of some preferred embodiments of the present invention relates to providing a massager, in accordance with preferred embodiments of the present invention that incorporates elements that provide skin treatment modalities additional to the massaging functions of the massager.

For example, in a preferred embodiment of the present invention a massager comprises heating elements that heat a region of skin being massaged by the massager. In accordance with another preferred embodiment of the present invention a massager incorporates ultrasound transducers for radiating acoustic waves into skin being massaged and tissue below the skin. The acoustic waves are useful for pain relief and aid in the breakup and absorption of salt deposits that form in joints and articulations and which often result in debility.

An aspect of some preferred embodiments of the present invention relates to providing a massager, hereinafter referred to as a "vacuum massager", for treating a person's skin in which a skin gripper is connected to a vacuum pump. Preferably, the layers that determine the shape of the gripping surface are flexible so that the gripping surface of the skin gripper is flexible. The vacuum pump removes air and provides a partial vacuum between the gripping surface of the skin gripper and a region of skin to which the skin gripper is applied. The vacuum massager, as with other massagers in accordance with preferred embodiments of the present invention, may comprise heating elements and/or ultrasound transducers. The action of the vacuum, in conjunction with electric fields in the skin and tissue under the skin generated by voltages applied to conductors in the conducting layer of the skin gripper, and/or ultrasound waves, and/or heat, aids in the removal of oils and pollutants from the skin and tissue below the skin.

An aspect of some preferred embodiments of the present invention relates to providing ornaments, clothes items and protective wear that are attached to a person's skin using at least one skin-gripper, in accordance with a preferred embodiment of the present invention.



In a preferred embodiment of the present invention a decorative element such as for example a decal, small "light show" display or a piece of jewelry is attached to a thin skin-gripper. A person wears the ornament by simply pressing the skin-gripper to an appropriate area of his or her skin.

5       Clothes items and protective wear can similarly be attached to a person's skin using skin-grippers. A nose guard used to protect a person's nose from sunlight can easily be kept in place using a skin-gripper, in accordance with a preferred embodiment of the present invention. Earplugs used by swimmer's to prevent water from entering their ears are notoriously difficult to keep properly in place.

10       An aspect of some preferred embodiments of the present invention relates to providing wearable decorative items that move over a person's body. For example, a small motile massager (hereinafter referred to as a "motile skin-gripper" when not used as a massager) might be disguised as a beautiful caterpillar that slowly creeps along the bared shoulders of a woman in a topless evening gown. Or a motile skin-gripper might be used to provide a choker that  
15       revolves slowly around the neck of its wearer to display different decorative elements in the choker.

There is therefore provided, in accordance with a preferred embodiment of the present invention a skin gripping apparatus for attracting and holding a region of skin comprising: a conducting layer comprising at least one conductor; a thin dielectric layer bonded to the  
20       conducting layer, which dielectric layer has a surface that is placed in contact with the region of skin so that the dielectric layer is between the conducting layer and the region of skin; and an electrical power supply that applies a potential difference between a conductor of the at least one conductor and the skin.

Preferably, the power supply is mechanically integrated with the at least one conductor.  
25       Preferably, the power supply comprises a receptacle for holding a source of power. Alternatively, power supply preferably comprises antenna and circuitry for receiving energy radiated from a power source and processing received energy to provide a desired potential difference between the conducting layer and the skin. In some preferred embodiments of the present invention the power supply is separate from and spatially removed from the at least one  
30       conductor.

In some preferred embodiments of the present invention the dielectric layer is formed from a flexible dielectric material. In some preferred embodiments of the present invention the

dielectric layer is formed with local dislocations that breakdown electrically to permit currents to flow from the at least one electrode to the region of skin.

In some preferred embodiments of the present invention the at least one conductor comprises at least one thin pliable conductor. In some preferred embodiments of the present invention the conducting layer is bonded to an insulating substrate. Preferably the insulating substrate is formed as a relatively thin flexible layer of insulating material.

Alternatively or additionally, the skin gripping apparatus is perforated with holes that extend from the region of skin to the air. Preferably, the walls of the holes are covered with an insulating material. Preferably, the insulating material covering the walls of the holes is bonded with the material in the insulating layer and the dielectric layer.

In some preferred embodiments of the present invention a voltage applied to at least one conductor is a time varying voltage.

In some preferred embodiments of the present invention the at least one conductor comprises a plurality of conductors. Preferably, the power supply applies a same voltage to each of the plurality of conductors. Alternatively, the power supply applies different voltages to at least two of the plurality of conductors.

In some preferred embodiments of the present invention a skin gripping apparatus comprises a layer of piezoelectric material excitable to generate ultrasound waves that penetrate the region of skin. In some preferred embodiments of the present invention a skin gripping apparatus comprises at least one heating element energizable to heat the region of skin. Preferably, the heating element is a Peltier thermocouple that can operate as a cooling element.

There is further provided in accordance with a preferred embodiment of the present invention a massaging apparatus for massaging the skin comprising: at least one skin gripping apparatus according to a preferred embodiment of the present invention; and a means for producing motion of surface regions of the dielectric layer of the at least one skin gripping apparatus that contact the skin.

Preferably, the means for producing motion comprises at least one handle for grasping the massaging apparatus and wherein motion of surface regions of the dielectric layer is produced by manually manipulating the at least one handle.

Alternatively or additionally, the dielectric surface of the at least one skin gripping apparatus is planar. Preferably, the layers of the skin gripping apparatus are stretchable and form a thin stretchable multilayer body. Preferably, the at least one handle comprises two

handles and wherein the two handles are manually pulled away from each other to stretch the stretchable body and produce motion of the surface regions of the dielectric layer in contact with the skin.

There is further provided in accordance with a preferred embodiment of the present invention a massaging apparatus for massaging the skin comprising: at least one skin gripping apparatus according to a preferred embodiment of the present invention; and a controller that controls the power supply to apply voltage differences between the region of skin and different ones of the plurality of conductors to generate forces that produce motion of the surface regions of the dielectric.

Preferably a gripping apparatus comprises a layer of piezoelectric material excitable to generate ultrasound waves that penetrate the region of skin. Alternatively or additionally, a gripping apparatus comprises at least one heating element energizable to heat the region of skin.

In some preferred embodiments of the present invention, all the layers of the skin gripping apparatus are flexible and form a thin flexible multilayer body. Preferably, the at least one conductor is a plurality of parallel narrow rectangular strip conductors having short and long edges. Preferably, the controller controls the power supply to apply voltage differences between the region of skin and different ones of the strip conductors to generate forces that produce wave motions in the flexible body that move back and forth in directions perpendicular to the long edges of the strip electrodes.

In some preferred embodiments of the present invention dielectric surface of the at least one skin gripping apparatus is curved.

In some preferred embodiments of the present invention the dielectric surface of the at least one skin gripping apparatus is cylindrical. In some preferred embodiments of the present invention the directrix of the cylindrical surface is a circle. In some preferred embodiments of the present invention the directrix of the cylindrical surface is an ellipse. In some preferred embodiments of the present invention the directrix of the cylindrical surface is a polygon.

In some preferred embodiments of the present invention the at least one skin gripping apparatus comprises a plurality of skin gripping apparatuses.

In some preferred embodiments of the present invention the at least one skin gripping apparatus rolls along the region of the skin.

In some preferred embodiments of the present invention the dielectric surface of at least one skin gripping apparatus comprises at least one protuberance. Preferably, the at least one

protuberance comprises a plurality of dimple shaped protuberances. Alternatively or additionally, the at least one protuberance comprises a plurality of raised ribs that protrude from the surface.

There is further provided, in accordance with a preferred embodiment of the present invention, a thermometer for measuring a person's temperature comprising: a skin gripping apparatus according to preferred embodiment of the present invention; a heat sensing element that is pressed by the skin gripping apparatus to a region of the person's skin that senses the person's temperature; and a display connected to the heat sensing element that displays the sensed temperature. Preferably, all the layers of the skin gripping apparatus are flexible. Preferably, the display is a flat panel display bonded to a layer of the skin gripping apparatus. Preferably, the flat panel display is a flexible flat panel display.

There is further provided, in accordance with a preferred embodiment of the present invention, a nose guard for protecting a person's skin from the sun comprising: at least one skin gripping apparatus according to a preferred embodiment of the present invention; a sun shade for the nose attached to the at least one skin gripping apparatus.

There is further provided, in accordance with a preferred embodiment of the present invention, a decorative ornament to be worn by a person comprising: at least one skin gripping apparatus according to a preferred embodiment of the present invention; and a decorative element attached to the at least one skin gripping apparatus. Preferably, the dielectric layer of the at least one skin gripping apparatus is cylindrical and the at least one conductor comprises a plurality of narrow rectangular conductors parallel to the axis of the cylindrical dielectric layer and wherein the power supply electrifies conductors sequentially to cause the at least one skin gripping apparatus to roll along the person's skin. Alternatively or additionally, the decorative element is preferably a piece of jewelry.

There is further provided, in accordance with a preferred embodiment of the present invention, a method of attaching an object to a person's skin comprising: attaching at least one conducting element coated with a thin layer of dielectric material to the object; placing the surface of the dielectric layer in contact with a region of skin; and applying a voltage between the electrode and the skin.

There is further provided, in accordance with a preferred embodiment of the present invention, a method of massaging a person's skin comprising: placing a conductor having a surface coated with a thin layer of dielectric material on the person's skin so that the surface of

the dielectric layer is contiguous with the skin; applying a voltage between the conductor and the skin; and moving the conductor.

5 There is further provided, in accordance with a preferred embodiment of the present invention, a medication, which is in the form of a paste or a gel, to a person, the method comprising: sandwiching the medication between a surface of a conductor coated with a thin dielectric layer; and applying a voltage between the conductor and the skin. Preferably the method comprises controlling the voltage to control the rate at which the substance is perfused.

10 There is further provided, in accordance with a preferred embodiment of the present invention, a method for treating blemishes on a region of person's skin comprising: placing on the region of skin an elastically stretchable, multi-layered body comprising a conducting layer coated with a thin dielectric layer so that the surface of the dielectric layer is contiguous with the skin; and repeatedly stretching and relaxing the layered body while the surface of the dielectric layer is in contact with the region of skin.

15 There is further provided, in accordance with a preferred embodiment of the present invention, a method for treating blemishes on a region of a person's skin comprising: positioning a surface of a body so that the surface contacts or is proximal with the region skin; and attracting the region of skin to the surface of the body so that blemishes in the region of skin are flattened to the surface of the body.

20 Preferably, positioning the surface comprises positioning a surface of a magnetized material proximal to the region of skin. Preferably, attracting the region of skin comprises adhering to the skin a magnetized foil that is attracted by magnetic forces to the surface of the magnetized material. Preferably, adhering to the skin comprises kneading the foil so that it contacts and sticks to skin in furrows of blemishes in the region of skin. Positioning a surface preferably comprises pressing a surface of a dielectric layer of a skin gripping apparatus  
25 according to a preferred embodiment of the present invention so that it contacts the region of skin.

In some preferred embodiments of the present invention, attracting the region of skin comprises: pressing the dielectric surface to the region of skin so that furrows of blemishes in the skin are flattened to the dielectric surface and contact the dielectric surface; and applying  
30 voltage to at least one electrode comprised in the gripping surface so that skin in the furrows is attracted to and sticks to the dielectric surface.

In some preferred embodiments of the present invention, attracting the region of skin comprises aspirating air from between the region of skin and the surface.

There is further provided, in accordance with a preferred embodiment of the present invention, a skin treatment device comprising: a skin gripping apparatus according to preferred embodiment of the present invention, having at least one conduit passing through layers in the skin gripping apparatus and terminating in an orifice in the dielectric layer; and a vacuum pump connected to the at least one conduit that aspirates air through the conduit. In some preferred embodiments of the present invention, the pump is a manually operated pump. In some preferred embodiments of the present invention, the pump is an electrically powered pump.

### BRIEF DESCRIPTION OF FIGURES

The invention will be more clearly understood by reference to the following description of preferred embodiments thereof, read in conjunction with the figures attached hereto. In the figures, identical structures, elements or parts which appear in more than one figure are labeled with the same numeral in all the figures in which they appear. The figures are listed below and:

Fig. 1 schematically shows a skin-gripper attached to a region of a person's skin, in accordance with a preferred embodiment of the present invention;

Fig. 2 schematically shows an electro-patch bandage comprising a skin-gripper having a flexible gripping body covering a wound, in accordance with a preferred embodiment of the present invention;

Figs. 3A and 3B schematically show different conductor configurations for the skin-gripper shown in Fig. 2, in accordance with a preferred embodiment of the present invention;

Fig. 4 schematically illustrates perfusing a medication through a person's skin using a skin-gripper in accordance with a preferred embodiment of the present invention;

Fig. 5 schematically shows a massager comprising a skin-gripper having a curved gripping surface being used to massage a person's skin, in accordance with a preferred embodiment of the present invention.

Fig. 6 schematically shows a massager comprising a circularly cylindrical gripping surface that is rolled over a person's skin to massage the skin, in accordance with a preferred embodiment of the present invention;

Figs. 7A and 7B schematically show in different perspective views a stretch massager comprising a stretchable skin-gripper, in accordance with a preferred embodiment of the present invention;

Figs. 7C – 7E show the stretch massager shown in Figs. 7A and 7B being used to treat wrinkles, in accordance with a preferred embodiment of the present invention;

Figs. 8A and 8B schematically show the use of a thin magnetized foil for treating wrinkles, in accordance with a preferred embodiment of the present invention;

Fig. 9A shows a pattern massager comprising a flexible skin-gripper, in accordance with a preferred embodiment of the present invention;

5 Figs. 9B – 9D schematically illustrate using the skin-gripper shown in Fig. 9A to massage a region of a person's skin, in accordance with a preferred embodiment of the present invention;

Fig. 10 schematically shows a motile massager moving over a person's skin, in accordance with a preferred embodiment of the present invention;

10 Figs. 11A and 11B schematically show two other motile massagers, in accordance with a preferred embodiment of the present invention;

Fig. 12A and 12B schematically show another motile massager being used to massage a person's skin, in accordance with a preferred embodiment of the present invention;

15 Fig. 13 schematically shows a massager comprising ultrasound transducers for treating a region of skin with ultrasound radiation, in accordance with a preferred embodiment of the present invention;

Fig. 14A schematically shows a vacuum massager being used to treat a person's skin, in accordance with a preferred embodiment of the present invention;

20 Figs. 14B and 14C schematically show features of the construction of the vacuum massager shown in Fig. 14A, in accordance with a preferred embodiment of the present invention;

Fig. 15 schematically shows a thermometer, being held to a person's forehead to measure the person's temperature, in accordance with a preferred embodiment of the present invention;

25 Fig. 16 schematically shows a nose guard comprising a skin-gripper for protecting a person's nose against sunburn, in accordance with a preferred embodiment of the present invention;

Fig. 17 schematically shows a piece of jewelry held in place on a person's neck by a skin-gripper in accordance with a preferred embodiment of the present invention; and

30 Fig. 18 shows schematically a "moving skin decoration" that comprises a motile skin-gripper, in accordance with a preferred embodiment of the present invention.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 schematically shows a skin-gripper 20, in accordance with a preferred embodiment of the present invention, in contact with a person's skin 22. Skin-gripper 20 and skin 22 are shown in a cutaway perspective view. The dimensions of elements and features shown in Fig. 1 and figures that follow are not necessarily to scale and are chosen for convenience of presentation.

Skin-gripper 20 comprises a conducting layer 24 bonded to a layer 26 of dielectric material. Preferably, the surface of conducting layer 24 not bonded with dielectric layer 26 is protected with a layer 28 of insulating material. A surface of dielectric layer 26 is in contact with skin 22. The surface is a gripping surface of skin-gripper 20. A power supply 30 generates a voltage difference  $V$ , i.e. a gripping voltage, between conducting layer 24 and skin 22.

Whereas power supply 30 is shown separate from the bonded layers of skin-gripper 20, in some preferred embodiments of the present invention, power supply 30 is attached to or integral with the layers. In some preferred embodiments of the present invention energy is supplied to power supply 30 by a battery. In some preferred embodiments of the present invention energy is supplied to power supply 30 from a photovoltaic converter or other source.

Skin 22, conducting layer 24 and dielectric insulating layer 26 function as a parallel plate capacitor charged by power supply 30 to the voltage  $V$ . As a result of the voltage difference between conducting layer 24 and skin 22, substantially equal and opposite surface charges are generated on conducting layer 24 and a region of skin 22 opposite conducting layer 24. In Fig. 1 the charges are represented by plus and minus signs and it is assumed, by way of example, that conducting layer 24 is charged positively.

The magnitude of the surface charge densities and the force of attraction between conducting layer 24 and skin 22 resulting from the charge densities may be calculated from the usual capacitor formulae. The magnitude of the generated surface charge densities is equal to  $\kappa\epsilon_0 V/d$ , where  $d$  and  $\kappa$  are the thickness and dielectric constant respectively of dielectric layer 26 and  $\epsilon_0$  is the permittivity of free space. The force of attraction per  $\text{cm}^2$  of surface area of conducting layer 24 is  $(\epsilon_0/2)(\kappa V/d)^2$ . By way of example, assuming  $V = 100$  volts,  $\kappa = 20$ , and  $d = 10$  microns, then the force between conducting layer 24 and skin 22 is  $20 \text{ N/cm}^2$  of surface area of conducting layer 24. In other words, a pull force of about 2 kg is needed to separate skin-gripper 20 from skin 22 for every  $\text{cm}^2$  of contact between dielectric layer 26 and skin 22.



It should be realized that once conducting layer 24 is charged and positioned on skin 22, conducting layer 24 discharges very slowly. Very little power therefore has to be supplied to maintain a given potential difference between conducting layer 24 and skin 22. Since power requirements of skin-gripper 20 are low, it is practical to supply power needed to maintain a given potential difference between conducting layer 24 and skin 22 by radiating power to skin-gripper 20. Therefore, in some preferred embodiments of the present invention power supply 40 is not wired to a source of energy such as a battery or a wall outlet. Instead energy is radiated to power supply 30 from an appropriate energy source. In these preferred embodiments of the present invention, skin-gripper 20 comprises antenna and circuitry for receiving the radiated energy and processing it to maintain a given potential between conducting layer 24 and skin 22. It is to be noted that antennae and circuitry appropriate for receiving and processing energy for use with skin-gripper 20 are well known in the art.

It should also be realized, that because of the low power requirements of skin-gripper 20, in some case it is possible to place skin-gripper 20 on skin 22, electrify it to a gripping voltage and then disconnect power supply 30. Skin-gripper 20 will remain attached to the skin with a strong gripping force for a substantial period of time since charge on conducting layer 24 leaks off very slowly.

Fig. 2 shows an electro-patch bandage 32 covering a wound (not shown) on a person's arm. Electro-patch bandage 32 preferably comprises a pliable skin-gripper 34. Skin-gripper 34 is preferably formed from a pliable conducting layer (not shown) comprising at least one conductor (not shown) sandwiched between a pliable insulating layer 36 and a thin dielectric layer 38. (In the perspective of Fig. 2 the conducting layer is not seen because layers 34 and 36 preferably extend beyond the edges of the conducting layer) A surface 39 (only an edge of which is shown) of dielectric layer 38 contacts the person's skin. Surface 39 is a gripping surface of skin-gripper 34.

A power supply 40 is preferably integrated with skin-gripper 34 and is preferably mounted on insulating layer 36. Power supply 40 generates a gripping voltage between the conducting layer and the skin on the person's arm. Preferably, power supply 40 comprises an appropriate switch, such as a pressure-activated switch, which is used to turn on power supply 40 when skin-gripper 34 is placed on the arm. A conducting ground strip 42 extends from power supply 40 so that a portion of ground strip 42 lies over gripping surface 39 of dielectric layer 38. Ground strip 42 assures proper electrical connection between power supply 40 and the

skin when electro-patch bandage 32 is placed on the skin. Preferably, ground strip 42 is silver-plated or made from silver, which is known to have beneficial anti-bacterial activity.

Because of its pliability, electro-patch bandage 32 conforms to the shape of a part of the body to which it is applied and thereby provides protection of a wound that it covers from ingress of contaminants.

The dimensions and shape of electro-patch bandage 32 have been chosen for ease and clarity of presentation and are not intended to imply a limitation of the invention. Different sizes and shapes of electro-patch bandages, in accordance with preferred embodiments of the present invention, are possible and can be advantageous. The size and shape of an electro-patch bandage, in accordance with a preferred embodiment of the present invention, can be tailored to the size and extent of a wound it is intended to cover.

In some preferred embodiments of the present invention, the conducting layer in an electro-patch bandage comprises an array having a plurality of conductors. In some preferred embodiments of the present invention conductors in the array are electrified by a power supply so as to generate an electrostatic field that has substantial components parallel to a region of skin to which the electro-patch bandage is applied. Preferably, adjacent conductors in the array are charged by the power supply to opposite polarity voltages to generate the electric field. In some preferred embodiments of the present invention, a varying voltage is applied to at least one conductor in the array so as to produce a time dependent electric field, such as an harmonically varying electric field, in the region of a wound covered by the electro-patch bandage. Time dependent electric fields cause motion of electrolytes in the skin and in tissue below the skin that generates internal heating of tissue in the region of the wound. In addition the fields create time varying pressure gradients that massage tissue in the region of the wound and increase blood flow to the injured region. Both the heating and massaging promote healing.

Figs. 3A and 3B schematically show two electro-patch bandages 44 and 46 that are variations of electro-patch bandage 32 shown in Fig. 2. In Figs. 3A and 3B gripping surfaces 39 of electro-patch bandage 44 and 46 and the portion of their ground strips 42 that lie on the gripping surfaces are shown. Electro patch bandages 44 and 46 exhibit two different arrays of conductors 48, in accordance with preferred embodiments of the present invention. Conductors 48, are shown in ghost lines because they are covered by their respective dielectric layers 38 and are not normally visible.

Conductors 48 are preferably individually electrifiable by power supply 40 (Fig. 2), which is grounded to the skin through ground strip 42, to generate different spatially and

temporally varying electric fields. Conductors 48 in Figs. 3A and Fig. 3B are shown with plus and minus signs indicating preferred patterns of electrification of conductors 48 that are used to generate electrostatic fields having components parallel to the skin. Other arrays of conductors and electrification patterns can be advantageous and will occur to persons of the art.

5           It is to be noted that static and time varying electric fields and electric fields with components parallel to the skin in a region of a skin wound are known to be beneficial to the healing process of wounds. US patent 4,142,521 to Konikoff, the disclosure of which is incorporated herein by reference, describes benefits to healing that result from the application of electrostatic fields to wounds. The patent describes a bandage comprising an electret for  
10   generating an electric field in the vicinity of a wound. The electret and bandage are held in place with gummed tape. US Patent 4,911,688 to J. P. Jones, the disclosure of which is incorporated herein by reference, describes covering a wound with a bandage that maintains a liquid layer over the wound. The bandage, which is held in place with an adhesive, comprises a means for producing an electric field in the liquid to enhance healing of the wound. Professor  
15   Joseph. W. Venable Jr. at internet site "[www.bio.purdue.edu/Bioweb/people/faculty/Venable](http://www.bio.purdue.edu/Bioweb/people/faculty/Venable)", reports on research indicating the importance of electric fields on wound healing in update of July 10, 1998 of the site, the disclosure of which is incorporated herein by reference.

          In some preferred embodiments of the present invention the dielectric layer in an electro-patch bandage, such as dielectric layer 38 shown in Figs. 2, 3A and 3B, is formed with  
20   a substantially uniform distribution of local dislocations in its structure. The dislocations are formed using methods known in the art such as by irradiating the dielectric layer with electrons or alpha particles. At appropriate gripping voltages, the dielectric layer breaks down in the regions of the local dislocations to enable small electrical micro-current pulses having current magnitudes ranging from a few pico-amperes to nano-amperes to flow between the conducting  
25   layer of the bandage and skin to which the electro-patch bandage is applied.

          Some electro-patch bandages in accordance with preferred embodiments of the present invention comprise a layer of piezoelectric material and a power supply for exciting ultrasound vibrations in the piezoelectric layer. The vibrations generate ultrasound waves that radiate into tissue in the region of a wound protected by the bandage. The piezoelectric layer and power  
30   supply are incorporated in the electro-patch bandage in a manner similar to the way in which incorporation of a piezoelectric layer in a massager, in accordance with a preferred embodiment of the present invention, is illustrated in Fig. 13 discussed below.

Fig. 4 schematically shows a skin-gripper 50 in a cross-section view, used to perfuse a medicine 52 into the body of a person through the person's skin 54. Skin-gripper 50 preferably has a structure similar to that of electro-patch bandage 32 shown in Fig. 2 and comprises a flexible insulating layer 56, a flexible conducting layer 58 preferably comprising a single conductor and a thin dielectric layer 60. A power supply 62 applies a potential difference between conducting layer 58 and skin 54. The potential difference generates surface charges on conductor 58 and skin 54, shown respectively with plus and minus signs, that result in a relatively large electric field and large attractive forces between skin-gripper 50 and skin 54.

Medication 52 is preferably applied in a thin layer (shown greatly exaggerated in thickness in Fig. 4) to dielectric layer 60. Preferably, medication 52 is a dielectric so that the amount by which the presence of medication 52 reduces the electric field at the surface of the skin is mitigated. The forces of attraction between skin-gripper 50 and skin 54 perfuse medication through skin 54. Preferably, medication 52 is restricted to a central portion of the area of the surface of dielectric layer 60. This tends to prevent medication 52 from being squeezed out along edges of skin-gripper 50.

If medication 52 comprises charged or polar molecules or particles, perfusion is enhanced by the electric field between skin-gripper 50 and skin 54. Perfusion of a medication using an electrophoretic effect is described in US Patent 4,767,401 to M. Seiderman, the disclosure of which is incorporated herein by reference. The patent describes "iontophoretic administration of ionizable or polar medicaments to a mammalian body" using a bandage that is held in place on the skin with an adhesive. The bandage comprises a metal electrode that in contact with the skin generates a voltaic electric field that perfuses the medication.

Fig. 5 schematically shows a cross section view a massager 64, in accordance with a preferred embodiment of the present invention, being used to massage a person's skin 66. Massager 64 preferably comprises a skin-gripper 68 having a curved gripping surface 70. Preferably, gripping surface 70 is formed by forming or adhering a conducting layer 72 on a curved substrate body 74 and laminating conducting layer 72 with a thin layer 76 (shown greatly exaggerated in thickness) of dielectric material. Substrate body 74 is preferably mounted to a handle 78 in which, preferably, a power supply (not shown) for electrifying conducting layer 72 with a gripping voltage, is mounted. Preferably, a conductor (not shown) is located on a curved edge of gripping surface 70 for providing electrical contact between the power supply and skin 66.

To operate massager 64, a gripping voltage is applied between conducting layer 72 and skin 66 such that gripping surface 70 is held firmly to skin 66. The massager is then and rocked back and forth as indicated by double-headed arrow 80. Because of the curved shape of gripping surface 70, as gripping surface 70 is rocked, it exercises skin 66 by repeatedly gripping, stretching and then releasing different regions of the skin to which it is pressed. In addition, the rocking motion and pressure with which gripping surface 70 is pressed to skin 66 mechanically massages skin 66 and tissue below the skin.

As in the case with electro-patch bandages, in some preferred embodiments of the present invention dielectric layer 76 is formed with a substantially uniform distribution of local dislocations in its structure. The dislocations promote the flow of small electrical micro-current pulses between conducting layer 72 and skin 66.

Fig. 6 shows another massager 84 in accordance with a preferred embodiment of the present invention being used to massage a region of skin on a persons back. Massager 84 comprises a skin-gripper 86 having a circularly cylindrical gripping surface 88 which is rolled back and forth over the region of skin being massaged. Attraction between gripping surface 88 and the skin exercises the skin in much the same way that massager 64 exercises the skin.

Massagers, in accordance with preferred embodiments of the present invention that operate similarly to massagers 64 and 84, but which comprise skin-grippers having gripping surfaces different from those of massagers 64 and 84 are possible and can be advantageous. For example, gripping surface 70 of massager 64 may be planar (in which case the gripping surface does not actually "rock" back and forth but tilts back and forth while holding and pulling the skin) or have a corrugated shape. Or it may be formed with a pattern of protruding dimples or parallel ribs that protrude from gripping surface 70. Circularly cylindrical gripping surface 88 of massager 84 may be a cylindrical surface defined by a directrix that is an ellipse, a polygon or an irregular closed curve. In some preferred embodiments of the present invention, the dimensions and shape of gripping surface 88 may vary along its axis. Other massagers, in accordance with preferred embodiments of the present invention comprise a plurality of separate cylindrical gripping surfaces, *i.e.* "wheels", that are mounted on a common axis and rolled over the skin in similar fashion to the way in which massager 84 is rolled over the skin. Still other geometries for massagers will occur to persons of the art. It should be noted that whereas many different shapes and configurations of shapes are possible for a gripping surface of a massager, in accordance with preferred embodiments of the present invention, different

shaped gripping surfaces may grip skin with different forces for a same applied voltage between the skin and the conducting layer in the massager.

Figs. 7A and 7B schematically show a massager 90, hereinafter referred to as "stretch massager 90", comprising a relatively thin stretchable skin-gripper 92 and two handles 100.

5 Fig. 7A shows stretch massager 90 in a side perspective view. In accordance with a preferred embodiment of the present invention, skin-gripper 92 comprises a stretchable, insulating substrate layer 94 and a conducting layer (not shown) preferably comprising a plurality of conductors bonded to substrate layer 94 in a preferably dense regular array. A thin stretchable dielectric layer 96 is bonded to the conducting layer. A surface 98 of dielectric layer  
10 96 is a gripping surface of skin-gripper 92. Handles 100 are preferably attached to skin-gripper 92 so as to enable skin-gripper 92 to be easily stretched manually.

Fig. 7B shows stretch massager 90 in a perspective view as seen from the gripping surface 98 side of skin-gripper 92. In Fig. 7B conductors 102 in the conducting layer of skin-gripper 92 are shown. Conductors 102 are shown in ghost lines because they are located under  
15 dielectric layer 96 and are not normally seen in the perspective of Fig. 7B. A power supply (not shown) for applying a gripping voltage to conductors 102 is preferably appropriately wired to each conductor 102, using methods known in the art so that when skin-gripper 92 is stretched, electrical contact between the power supply and each conductor 102 is maintained. Preferably the power supply is grounded to ground conductors 103 that are located on the surface of  
20 dielectric layer 96 under each handle 100. When stretch massager 90 is used to treat a person's skin, ground electrodes 100 are pressed to the skin, thereby grounding the power supply to the skin. In some preferred embodiments of the present invention, the power supply is grounded to the skin through a conductor attached to the skin using methods known in the art or by using a skin gripper in accordance with a preferred embodiment of the present invention that presses  
25 the conductor to the skin.

Whereas conductors 102 in Fig. 7B are square, conductors in a stretchable skin-gripper, in accordance with a preferred embodiment of the present invention, may have various shapes and be arrayed in different patterns. For example, in some preferred embodiments of the present invention, conductors in a stretchable skin-gripper are small thin circular, hexagonal or  
30 diamond shaped conductors mounted to a substrate in a densely packed regular array. In accordance with another preferred embodiment of the present invention the conductors are parallel closely spaced narrow rectangular conductors. In yet other preferred embodiments of the present invention the conductors are arranged in a closely woven conducting mesh that is

itself stretchable. Still other geometries and arrays of conductors are possible and can be advantageous and these will occur to a person of the art.

Figs. 7C – 7E schematically illustrate stretch massager 90 being used to treat wrinkles 104 (shown in Fig. 7C) in a region of skin 106, in accordance with a preferred embodiment of the present invention. In Figs. 7C – 7E skin-gripper 92 and skin 106 are shown in cross-section. Wrinkles 104 are defined by ridges 108 and furrows 110.

In Fig. 7C skin-gripper 92 is shown positioned on skin 106 in an "unstretched" state and with conductors 102 raised to a gripping voltage by the power supply. Skin on ridges 108 of wrinkles 104 contact gripping surface 98 and is held fast to gripping surface 98. On the other hand, skin in furrows 110 of wrinkles 104 is not in contact with gripping surface 98.

In Fig. 7D skin-gripper 92 is stretched in directions indicated by arrows 112. Ridges 108 of wrinkles 104, which are held fast to gripping surface 98, are pulled apart. As a result, furrows 110 of wrinkles 104 are flattened out and skin in the flattened furrows comes into contact with gripping surface 98. Once in contact with gripping surface 98, skin in flattened furrow 110 is held fast by gripping surface 98.

In Fig. 7E skin-gripper 92 has been allowed to return to its unstretched state as indicated by arrows 114. However, even after skin-gripper 92 has been returned to its unstretched state, skin in furrows 110 that has come in contact with gripping surface 98 remains in contact with gripping surface 98. As a result, even when skin-gripper 92 is released to its unstretched state, wrinkles 104 remain flattened to gripping surface 98.

By repeatedly stretching and releasing skin-gripper 92 skin 106 is exercised and blood flow to skin 106 is increased. The exercise and stimulation improves skin tone and is conducive to the reduction of wrinkling. In some preferred embodiments of the present invention, as in the case with massagers described above, skin-gripper 92 is constructed so that skin 106 is also stimulated by micro-currents that flow through dielectric layer 96.

In some preferred embodiments of the present invention magnetic fields are used to attract regions of skin located in furrows of wrinkles and smooth thereby the wrinkles by flattening them to an appropriate surface. Figs. 8A and 8B schematically illustrate a method for treating wrinkles using a thin magnetic foil 350 and a relatively thick magnetic "bracing layer" 352 to treat wrinkles 354, one of which is shown in Figs. 8A and 8B, on a region of skin 356. Wrinkle 354 shown in 8A and 8B is defined by a furrow 358. In Figs. 8A and 8B skin 356, foil 350 and bracing layer 352 are shown in cross section.

Referring to Fig. 8A, a surface 360 of magnetic foil 352 covered with an adhesive material (not shown) is placed in contact with and kneaded to skin 354. As a result of the adhesive and kneading, surface 360 sticks strongly to skin 356. The thickness of foil 352 and its Young's modulus are determined, in accordance with a preferred embodiment of the present invention, so that when kneaded, foil 352 molds to furrow 358 of wrinkle 354 in skin 356. Fig. 8A schematically shows foil 352 after it has been kneaded and formed to furrow 358 of wrinkle 354. Surface 360 is shown distanced from skin 356 for convenience of presentation.

An appropriate foil suitable for use as foil 352, in accordance with a preferred embodiment of the present invention, is, by way of example, a 25 micron foil formed from a flexible plastic having a Young' modulus preferably equal to about  $10^9$  Pa (pascal = 1 newton/m<sup>2</sup>), which is magnetized using methods known in the art. Such foils are known in the art and are manufactured, for example, by Bloomer Plastics Inc. of Bloomer, WI, USA. Young's modulus for skin typically has values in a range from  $10^6$  to  $10^7$  Pa. The average thickness of skin is about 1 mm. A plastic foil having the noted characteristics therefore has substantially negligible bending rigidity compared to skin and can therefore relatively easily be kneaded into wrinkles in the skin.

After foil 352 is intimately stuck to skin 356 as described above, bracing layer 362 is pressed to the foil. Magnetic forces between foil 352 and bracing layer 362 attract foil 352 to bracing layer 362 and flatten foil 352, and thereby furrow 358 of wrinkle 354 to bracing layer 362. Fig. 8B shows bracing layer 362 pressed to foil 352 and foil 352 and wrinkle 354 flattened to bracing layer 362.

Bracing layer 362 and foil 352 are left in place for a convenient period of time, such as the duration of an afternoon nap or of a mudpack application in a beauty parlor. Bracing layer 362 and foil 352 are periodically applied to skin 354 to "iron out" and reduce wrinkles on the skin.

Whereas bracing layer 362 is shown as planar and "static", bracing layer 362 can, in accordance with a preferred embodiment of the present invention, be a surface of a roller that is rolled over foil 352 or a cylindrical surface that is rocked back and fourth over foil 352.

In accordance with some preferred embodiments of the present invention, bracing layer 362 comprises a layer of piezoelectric material and a power supply for exciting ultrasound vibrations in the piezoelectric layer. The ultrasound vibrations radiate ultrasound into tissue in the region of skin being treated with bracing layer 362 and foil 352. The piezoelectric layer and power supply are preferably integrated with bracing layer 362 in a manner similar to the way in



which a piezoelectric layer is integrated with dielectric layer 222 shown in Fig. 13 and discussed below. In some preferred embodiments of the present invention bracing layer 362 comprises a heating element for heating treated skin. In some preferred embodiments of the present invention, the heating element is a Peltier thermocouple that can function as both a heating element and a cooling element. A region of skin being treated to reduce wrinkling with foil 352 and bracing layer 362 is alternately heated and cooled to treat wrinkles.

Whereas a Peltier thermocouple has been discussed with reference to bracing layer 362, it should be noted that Peltier thermocouples can be coupled, where advantageous, to skin grippers used in massagers and other devices, in accordance with preferred embodiments of the present invention.

Fig. 9A schematically shows a "pattern massager" 120 comprising a flexible skin-gripper 122 used to massage the skin. Skin-gripper 122 comprises a flexible insulating substrate 124 and a flexible dielectric layer 126 having a gripping surface 127. A conducting layer 128 sandwiched between layers 124 and 126 preferably comprises a plurality of relatively thin parallel strip conductors 130 shown with ghost lines. Each strip conductor 130 is electrified independently of other strip conductors 130 by a power supply (not shown) that is connected to strip electrodes 130 by an appropriate switching circuit (not shown). The power supply is grounded to the skin through a grounding conductor attached to the skin using methods known in the art or by using a skin gripper in accordance with a preferred embodiment of the present invention that presses the conductor to the skin. In some preferred embodiments of the present invention, the grounding conductor is pressed to the skin by the action of strip conductors 130 that are electrified to press the grounding conductor to the skin during the time that pattern massager 120 is in operation.

To massage the skin, skin-gripper 122 is placed on the skin and the power supply and switching circuit are controlled to apply gripping voltages to strip-conductors 130 in varying spatial and/or temporal patterns. As different strip conductors 130 are electrified with gripping voltages, different areas of the skin in contact with skin-gripper 122 are gripped and exercised.

Figs. 9B – 9D schematically illustrate a method by which skin-gripper 122 massages a region of a person's skin 132, in accordance with a preferred embodiment of the present invention. In Figs. 9B – 9D skin-gripper 122 and skin 132 are shown in a cross section view that is perpendicular to the lengths of strip conductors 130.

Skin-gripper 122 is preferably attached and "anchored" in place to skin 132 by placing ends 140 and 142 of skin-gripper 122 in contact with skin 132 and controlling the power

supply and switching circuit to apply a gripping voltage to at least one strip conductor 130 at each of ends 140 and 142. Preferably the distance between ends 140 and 142 on skin 132 is less than the length of skin-gripper 122. Therefore, at any one time not all of gripping surface 127 can be in contact with skin 132.

5 To massage skin 132, in accordance with a preferred embodiment of the present invention, the power supply and switching circuit are controlled to electrify at any one time, preferably only one or a small group of adjacent strip conductors 130 located between ends 140 and 142 of skin-gripper 122. In Figs. 9B - 9D, by way of example, a group of three conductors 130 between ends 140 and 142 are electrified by being charged positively with respect to skin  
10 132. Electrified strip conductors 130 are indicated by + signs over the conductors. As a result, at any one time, skin-gripper 122 contacts and grips skin 132 only along a strip 144 of skin 132 opposite electrified conductors 130. Strip 144 is shown between witness lines 146 and 148 and has a negative induced charge indicated by minus signs.

By electrifying different strip conductors 130 so as to move the position of the group of  
15 electrified conductors 130 right or left, the position of strip 144 that is gripped by skin-gripper 122, is moved right or left. Figs. 9B - 9D schematically show, by way of example, the position of strip 144 at respectively later times as electrified strip conductors 130 are "moved" to the right along skin-gripper 122, in accordance with a preferred embodiment of the present invention. As a result of the motion of strip 144 a travelling wave appears to be moving along  
20 skin-gripper 122 to the right. The motion of the gripped area of skin massages the skin. As with other massagers described above, in some preferred embodiments of the present invention, micro-currents flow to the skin at points of contact between skin-gripper 122 and skin 132.

Whereas Figs. 9B - 9D show skin-gripper 122 contacting skin 132 only along one strip between ends 140 and 142, in some preferred embodiments of the invention skin-gripper 122  
25 contacts skin 132 along more than one strip between ends 140 and 142. Furthermore, flexible skin-grippers, in accordance with preferred embodiments of the present invention, may comprise arrays of conductors having conductor shapes and configurations different from the configuration of conductors comprised in wave massager 122, and these different arrays can be advantageous. For example, because conductors 130 are arranged in a one dimensional array,  
30 skin-gripper 122 can provide a gripping area that moves back and forth only along a single direction, the direction perpendicular to the lengths of strip conductors 130. (The conductor array in skin-gripper 122 is one dimensional because the array is formed by positioning strip conductors 130 parallel to each other along a single direction.) In some pattern massagers, in

accordance with preferred embodiments of the present invention, conductors in a conducting layer of a skin-gripper comprised in the pattern massager are arranged in a two dimensional array. For example a pattern massager, in accordance with a preferred embodiment of the present invention, might have a conductor array similar to the two dimensional conductor array of stretch massager 90 shown in Fig. 7B. With a two-dimensional conductor array a gripped area can be moved in two directions over a region of skin that is in contact with the pattern massager.

Fig. 10 schematically shows a perspective cross section view of a motile massager 150 moving over a person's skin 152, in accordance with a preferred embodiment of the present invention. Motile massager 150 preferably comprises a skin-gripper 154 having a circularly cylindrical gripping surface 156 formed from a plurality of identical parallel strip conductors 158 covered with a dielectric layer (not shown). A power supply (not shown) and switching circuit (not shown) electrify strip conductors 158 independently of each other. Preferably, two ground strips 159 (only one of which is shown) that completely band gripping surface 156, one at each end of gripping surface 156, are used for grounding the power supply to skin 152.

At any one time only a portion of gripping surface 156 contacts skin 152 and strip conductors 158 in the portion are charged to a gripping voltage to grip skin 152 and hold skin-gripper 154 to the skin. In Fig. 10 strip conductors 158 that are charged to grip skin 152 are indicated, by way of example, as being charged positive with respect to skin 152. In some preferred embodiments of the present invention strip conductors 158 are charged negatively with respect to skin 152.

Skin-gripper 154 rolls over skin 152 by itself. To accomplish this the power supply is switched by the switching circuit to repeatedly, substantially simultaneously, discharge a strip conductor 158 at one edge of a group of charged strip conductors 158 that are gripping skin 152 and charge a strip conductor 158 at the opposite edge of the group of strip conductors 158. As a result of the charging and discharging of strip conductors 158 in this manner, skin-gripper 154 rolls in the direction of the edge of the group of strip conductors 158 along which strip conductors 158 are being charged. For example, in Fig. 10, skin-gripper 154 will roll in the direction of arrow 160 if the strip conductor 158 labeled with numeral 162 is charged and the strip conductor 158 labeled with numeral 164 is discharged.

In operation, after skin-gripper 154 rolls along the skin for a desired distance, the power supply and switching circuit "reverse direction" so that skin-gripper 154 rolls back and forth over a desired region of skin. The rolling motion of skin-gripper 154 massages skin 152. In

some preferred embodiments of the present invention, skin-gripper 154 is constructed so that electrical micro-currents flow between strip conductors 158 that contact skin 152 and skin 152 in a similar manner as described above and to provide similar beneficial effects.

Geometries for motile massagers, in accordance with preferred embodiments of the present invention, that are different from the geometry of motile massager 150 are possible and can be advantageous. For example, a motile massager 170 in accordance with a preferred embodiment of the present invention may comprise a cylindrical gripping surface 172 defined by a directrix that is an equilateral polygon as shown in Fig. 11A. Strip conductors 174 are located on panels 176 of polygonal cylindrical surface 172 and are electrified by an appropriate power supply (not shown) to rotate gripping surface 172 in similar manner to the way strip conductors 158 of skin-gripper 154 shown in Fig. 10 are electrified to rotate skin-gripper 154. Or, by way of another example, a motile massager 180, as shown in Fig. 11B, may comprise a plurality of skin-grippers 182 having circularly cylindrical gripping surfaces 184 and strip conductors 186.

Figs. 11A and 12B schematically show a cross section view of two positions of a motile massager 200 that rocks by itself back and forth over a persons skin 202. Motile massager 200 comprises a skin-gripper 204 having a cylindrical gripping surface 206 comprising strip conductors 208 (only the edges of which are shown in Figs. 11A and 12B) similar to strip conductors 158 of skin-gripper 154 shown in Fig. 10. As in the case of skin-gripper 154, at any one time only a portion of gripping surface 206 contacts skin 202 and only some strip conductors 208 are charged to attract and grip an area of skin 202. And in similar manner to the way in which skin-gripper 154 is rolled along a person's skin, skin-gripper 204 is rocked back and forth over skin 202 by appropriately charging and discharging strip conductors along the edges of a group of strip conductors gripping skin 202.

Fig. 13 schematically shows a massager 210, similar to massager 64 shown in Fig. 5, for treating a region of skin 212 with ultrasound radiation as the skin is massaged, in accordance with a preferred embodiment of the present invention.

Massager 210 comprises a skin-gripper 211 having a substrate body 214 to which is bonded a piezoelectric layer 216 sandwiched between two conducting layers 218 and 220. Conducting layer 220 is covered with a thin dielectric layer 222. Surface 224 of dielectric layer 222 is a gripping surface of skin-gripper 212.

A high frequency power supply 226 generates a high frequency AC voltage between conducting layers 218 and 220 to excite ultrasound vibrations in piezoelectric layer 216. A DC

power supply 228 generates a potential difference, *i.e.* a gripping potential, between conducting layer 220 and skin 212. Preferably, contact between DC power supply 228 and skin 212 is made through a conducting strip (not shown) located on gripping surface 224 or through an electrode (not shown) attached and held to skin 212 by a skin-gripper powered by DC power supply 228. When massager 210 is rocked back and forth on skin 212 ultrasound waves are radiated into skin 212 and into tissue below skin 212 at the area of contact between gripping surface 224 and skin 212.

Whereas Fig. 13 shows a piezoelectric layer integrated with a massager having a relatively non-flexible gripping surface, piezoelectric transducers for providing ultrasound stimulation of a massaged region may be incorporated into flexible and stretchable massagers, in accordance with preferred embodiments of the present invention. For example, flexible pattern massager 120 shown in Fig. 9A may comprise a flexible piezoelectric layer and stretch massager 90 shown in Fig. 7B may be "seeded" with a plurality of piezoelectric transducers that do not interfere substantially with the "stretchability" of the massager.

Fig. 14A schematically shows a vacuum massager 300, in accordance with a preferred embodiment of the present invention. Vacuum massager 300 uses a vacuum to treat the skin of a patient. In Fig. 14A vacuum massager 300 is shown being used to treat a region of skin 302 on the back of a patient 304.

Vacuum massager 300 comprises a skin gripper 306, in the form of a flange that is connected to a vacuum pump 308. Preferably, skin gripper 306 is flexible. Vacuum pump 308 is used to evacuate air and produce a partial vacuum between the gripping surface (which is in contact with skin 302 and not shown) of skin gripper 306 and skin 302. Vacuum pump 308 may be a manually operated vacuum pump or an electrically operated vacuum pump. In Figs. 13A and 13B vacuum pump 308 is shown, by way of example as a manually operated bulb type vacuum pump comprising a flexible bulb 310 connected to skin gripper 306 by a "neck" 312. Vacuum pump 308 evacuates air between skin gripper 306 and the patient's skin 302 preferably through a central air channel (not shown) in neck 312 when bulb 310 is repeatedly squeezed and released.

The conducting layer of skin gripper 306 preferably comprises a plurality of flexible conductors (not shown). A power supply (not shown) electrifies conductors to grip the skin and generate static and/or electric fields to treat the skin and tissue beneath the skin. Some vacuum massagers, in accordance with preferred embodiments of the present invention, comprise a

piezoelectric layer for generating ultrasound waves to treat the skin and/or a heating element to treat the skin with heat.

Fig. 14B schematically shows vacuum massager 300 in cross section view taken through a line AA shown in Fig. 14A. Skin gripper 306 comprises a gripping surface 314. Conductors in the conducting layer of skin gripper 306 preferably do not cross the plane of the cross section perspective of Fig. 14B and conductors in the conducting layer are not shown. Neck 312 of vacuum massager 300 comprises a central air channel 316. Central air channel 316 is fitted with a one way valve 318 that permits air to flow only in a direction into bulb 310. Preferably, air channel 316 extends through gripping surface 314 so that air is evacuated from between skin 302 and gripping surface 314 directly through central air channel 316. Preferably, central air channel 316 is connected to a plurality of manifold air channels 318, two of which are shown in the cross section view of Fig. 14B, that extend radially from central air channel 316. Each manifold channel 318 is preferably connected by a plurality of secondary air channels 320 that extend from the manifold channel through gripping surface 314 and through which air is aspirated.

Fig. 14C shows a view of gripping surface 314 of skin gripper 306 that shows openings 322 in gripping surface 314 that are located at points where secondary air channels 320 extend through gripping surface 314. Preferably, the conducting layer of skin gripper 300 comprises triangular shaped conductors 315 that are located between the rows of openings 322. Conductors 315 are shown in ghost lines because they are located under gripping surface 314. Conductor configurations different from that shown in Fig. 14C, including configurations in which conductors intrude into spaces between secondary air channels 320, are possible and can be advantageous and these configurations will occur to a person of the art. Furthermore, configurations of air channels for evacuating air from between skin gripper 306 and skin 302 other than that shown in Figs. 14B and 14C, are possible and can be advantageous and will occur to a person of the art.

Fig. 15 schematically shows a thermometer 240 comprising a thin flexible skin-gripper 242, in accordance with a preferred embodiment of the present invention, attached to a person's forehead to measure the person's temperature. Thermometer 240 comprises a heat sensing element (not shown), such as for example a thin foil thermometer common in the art, which is held in place on the forehead by skin-gripper 240. An appropriate flexible flat panel display 244 is mounted to the skin-gripper to display a temperature reading. Whereas thermometer 244 is placed on the forehead it is obvious that it can be placed elsewhere on the body.

Fig. 16 schematically shows a "nose guard" 250 for protecting a person's nose from the sun's rays and preventing sunburn, in accordance with a preferred embodiment of the present invention. Nose guard 250 comprises a flexible shade 252 mounted to a flexible skin-gripper 254. Skin-gripper 254 is shown as a shaded region, and grips the nose strongly in regions of the nose near the nostrils.

Fig. 17 schematically shows a decorative piece of jewelry 260 mounted on a skin-gripper (behind the piece of jewelry in the Fig. 17) that holds the piece of jewelry in place on a woman's neck, in accordance with a preferred embodiment of the present invention.

Fig. 18 schematically shows a woman wearing a decorative "caterpillar" 270, which is shown in a partial cutaway view, that is formed on a "small" motile skin-gripper 272, so that caterpillar 270 moves along the woman's shoulder. Motile skin-gripper 272 may be similar in shape and construction to motile massager 180 shown in Fig. 11B. Motile skin-gripper 272 comprises a power supply and switching circuitry controlled to electrify strip conductors in motile skin-gripper 272 so that caterpillar 270 moves back and forth along the woman's neck.

In the description and claims of the present application, each of the verbs, "comprise" "include" and "have", and conjugates thereof, are used to indicate that the object or objects of the verb are not necessarily a complete listing of components, elements or parts of the subject or subjects of the verb.

The present invention has been described using detailed descriptions of preferred embodiments thereof that are provided by way of example and are not intended to limit the scope of the invention. The described preferred embodiments comprise different features, not all of which are required in all embodiments of the invention. Some embodiments of the present invention utilize only some of the features or possible combinations of the features. Variations of embodiments of the present invention that are described and embodiments of the present invention comprising different combinations of features noted in the described embodiments will occur to persons of the art. The scope of the invention is limited only by the following claims.

### CLAIMS

1. A skin gripping apparatus for attracting and holding a region of skin comprising:  
a conducting layer comprising at least one conductor;  
a thin dielectric layer bonded to the conducting layer, which dielectric layer has a  
5 surface that is placed in contact with the region of skin so that the dielectric layer is between  
the conducting layer and the region of skin; and  
an electrical power supply that applies a potential difference between a conductor of the  
at least one conductor and the skin.
- 10 2. A skin gripping apparatus according to claim 1 wherein the power supply is  
mechanically integrated with the at least one conductor.
3. A skin gripping apparatus according to claim 2 the power supply comprises a receptacle  
for holding a source of power.
- 15 4. A skin gripping apparatus according to claim 2 wherein the power supply comprises  
antenna and circuitry for receiving energy radiated from a power source and processing  
received energy to provide a desired potential difference between the conducting layer and the  
skin.
- 20 5. A skin gripping apparatus according to claim 1 wherein the power supply is separate  
from and spatially removed from the at least one conductor.
6. A skin gripping apparatus according to any of claims 1 - 5 wherein the dielectric layer  
25 is formed from a flexible dielectric material.
7. A skin gripping apparatus according to any of claims 1 - 6 wherein the dielectric layer  
is formed with local dislocations that breakdown electrically to permit currents to flow from  
the at least one conductor to the region of skin.
- 30 8. A skin gripping apparatus according to any of claims 1 - 7 wherein the at least one  
conductor comprises at least one thin pliable conductor.



9. A skin gripping apparatus according to any of claims 1 - 8 wherein the conducting layer is bonded to an insulating substrate.
10. A skin gripping apparatus according to claim 9 wherein the insulating substrate is formed as a relatively thin flexible layer of insulating material.
11. A skin gripping apparatus to claim 9 or claim 10 wherein the skin gripping apparatus is perforated with holes that extend from the region of skin to the air.
12. A skin gripping apparatus according to claim 11 wherein the walls of the holes are covered with an insulating material.
13. A skin gripping apparatus according to claim 12 wherein the insulating material covering the walls of the holes is bonded with the material in the insulating layer and the dielectric layer.
14. A skin gripping apparatus according to any of claims 1 - 13 wherein a voltage applied to at least one conductor is a time varying voltage.
15. A skin gripping apparatus according to any of claims 1 - 14 wherein the at least one conductor comprises a plurality of conductors.
16. A skin gripping apparatus according to claim 15 wherein the power supply applies a same voltage to each of the plurality of conductors.
17. A skin gripping apparatus according to claim 15 wherein the power supply applies different voltages to at least two of the plurality of conductors.
18. A skin gripping apparatus according to any of claims 1 - 17 and comprising a layer of piezoelectric material excitable to generate ultrasound waves that penetrate the region of skin.
19. A skin gripping apparatus according to any of claims 1 - 18 and comprising at least one heating element energizeable to heat the region of skin.

20. A skin gripping apparatus according to claim 19 wherein the at least one heating element is a Peltier thermocouple that can operate as a cooling element.

21. A massaging apparatus for massaging the skin comprising:

at least one skin gripping apparatus according to any of claims 1 - 20 ; and

a means for producing motion of surface regions of the dielectric layer of the at least one skin gripping apparatus that contact the skin.

22. A massaging apparatus according to claim 21 wherein the means for producing motion comprises at least one handle for grasping the massaging apparatus and wherein motion of surface regions of the dielectric layer is produced by manually manipulating the at least one handle.

23. A massaging apparatus according to claim 21 or claim 22 wherein the dielectric surface of the at least one skin gripping apparatus is planar.

24. A massaging apparatus according to claim 22 wherein all the layers of the skin gripping apparatus are stretchable and form a thin stretchable multilayer body.

25. A massaging apparatus according to claim 24 wherein the at least one handle comprises two handles and wherein the two handles are manually pulled away from each other to stretch the stretchable body and produce motion of the surface regions of the dielectric layer in contact with the skin.

26. A massaging apparatus for massaging the skin comprising:

at least one skin gripping apparatus according to any of claims 17 - 20 ; and

a controller that controls the power supply to apply voltage differences between the region of skin and different ones of the plurality of conductors to generate forces that produce motion of the surface regions of the dielectric.

27. A skin gripping apparatus according to claim 26 wherein a gripping apparatus of the at least one gripping apparatus comprises a layer of piezoelectric material excitable to generate ultrasound waves that penetrate the region of skin.

28. A skin gripping apparatus according to claim 26 or claim 27 wherein a gripping apparatus of the at least one gripping apparatus comprises at least one heating element energizeable to heat the region of skin.

5

29. A massaging apparatus according to any of claims 26 - 28 wherein all the layers of the at least one skin gripping apparatus are flexible and form a thin flexible multilayer body.

30. A massaging apparatus according to claim 29 wherein the at least one conductor is a plurality of parallel narrow rectangular strip conductors having short and long edges.

10

31. A massaging apparatus according to claim 30 wherein the controller controls the power supply to apply voltage differences between the region of skin and different ones of the strip conductors to generate forces that produce wave motions in the flexible body that move back and forth in directions perpendicular to the long edges of the strip conductors.

15

32. A massaging apparatus according to any of claims 21 - 23, 26 - 28 wherein the dielectric surface of the at least one skin gripping apparatus is curved.

33. A massaging apparatus according to any of claims 21 - 23 or 26 - 28 wherein the dielectric surface of the at least one skin gripping apparatus is cylindrical.

20

34. A massaging apparatus according to claim 33 wherein the directrix of the cylindrical surface is a circle.

25

35. A massaging apparatus according to claim 33 wherein the directrix of the cylindrical surface is an ellipse.

36. A massaging apparatus according to claim 33 wherein the directrix of the cylindrical surface is a polygon.

30

37. A massaging apparatus according to any of claims 22, 23, 26 - 28, or claims 31 - 35 wherein the at least one skin gripping apparatus comprises a plurality of skin gripping apparatuses.

5 38. A massaging apparatus according to any of claims 32 - 36 wherein the at least one skin gripping apparatus rolls along the region of the skin.

39. A massaging apparatus according any of claims 21 - 38 wherein the dielectric surface of at least one skin gripping apparatus comprises at least one protuberance.

10 40. A massaging apparatus according to claim 39 wherein the at least one protuberance comprises a plurality of dimple shaped protuberances.

15 41. A massaging apparatus according to claim 39 or claim 40 wherein the at least one protuberance comprises a plurality of raised ribs that protrude from the surface.

42. A thermometer for measuring a person's temperature comprising:  
a skin gripping apparatus according to any of claims 1 - 17;  
a heat sensing element that is pressed by the skin gripping apparatus to a region of the  
20 person's skin that senses the person's temperature; and  
a display connected to the heat sensing element that displays the sensed temperature.

43. A thermometer according to claim 42 wherein all the layers of the skin gripping apparatus are flexible.

25 44. A thermometer according to claim 43 wherein the display is a flat panel display bonded to a layer of the skin gripping apparatus.

45. A thermometer according to claim 44 wherein the flat panel display is a flexible flat  
30 panel display.

46. A nose guard for protecting a person's skin from the sun comprising:  
at least one skin gripping apparatus according to any of claims 1 - 17;

a sun shade for the nose attached to the at least one skin gripping apparatus.

47. A decorative ornament to be worn by a person comprising:

at least one skin gripping apparatus according to any of claims 1 - 14; and

a decorative element attached to the at least one skin gripping apparatus.

48. A decorative ornament according to claim 47 wherein the dielectric layer of the at least one skin gripping apparatus is cylindrical and the at least one conductor comprises a plurality of narrow rectangular conductors parallel to the axis of the cylindrical dielectric layer and wherein the power supply electrifies conductors sequentially to cause the at least one skin gripping apparatus to roll along the person's skin.

49. A decorative ornament according to claim 47 or claim 48 wherein the decorative element is a piece of jewelry.

50. A method of attaching an object to a person's skin comprising:

attaching at least one conducting element coated with a thin layer of dielectric material to the object;

placing the surface of the dielectric layer in contact with a region of skin; and

applying a voltage between the electrode and the skin.

51. A method of massaging a person's skin comprising:

placing a conductor having a surface coated with a thin layer of dielectric material on the person's skin so that the surface of the dielectric layer is contiguous with the skin;

applying a voltage between the conductor and the skin; and

moving the conductor.

52. A method of administering a medication, which is in the form of a paste or a gel, to a person, the method comprising:

sandwiching the medication between a surface of a conductor coated with a thin dielectric layer; and

applying a voltage between the conductor and the skin.

53. A method according to claim 52 and comprising controlling the voltage to control the rate at which the substance is perfused.

54. A method for treating blemishes on a region of person's skin comprising:

5 placing on the region of skin an elastically stretchable, multi-layered body comprising a conducting layer coated with a thin dielectric layer so that the surface of the dielectric layer is contiguous with the skin; and

repeatedly stretching and relaxing the layered body while the surface of the dielectric layer is in contact with the region of skin.

10 55. A method for treating blemishes on a region of a person's skin comprising:

positioning a surface of a body so that the surface contacts or is proximal with the region skin; and

15 attracting the region of skin to the surface of the body so that blemishes in the region of skin are flattened to the surface of the body.

56. A method according to claim 55 wherein positioning the surface comprises positioning a surface of a magnetized material proximal to the region of skin.

20 57. A method according to claim 56 wherein attracting the region of skin comprises adhering to the skin a magnetized foil that is attracted by magnetic forces to the surface of the magnetized material.

25 58. A method according to claim 57 wherein adhering to the skin comprises kneading the foil so that it contacts and sticks to skin in furrows of blemishes in the region of skin.

59. A method according to claim 58 wherein positioning a surface comprises pressing a surface of a dielectric layer of a skin gripping apparatus according to any of claims 1 -20 so that it contacts the region of skin.

30 60. A method according to claim 59 wherein attracting the region of skin comprises:  
pressing the dielectric surface to the region of skin so that furrows of blemishes in the skin are flattened to the dielectric surface and contact the dielectric surface; and

applying voltage to at least one electrode comprised in the gripping surface so that skin in the furrows is attracted to and sticks to the dielectric surface.

61. A method according to any of claims 55 - 60 wherein attracting the region of skin  
5 comprises aspirating air from between the region of skin and the surface.
62. A skin treatment device comprising:  
a skin gripping apparatus according to any of claims 1 - 20 having at least one conduit  
passing through layers in the skin gripping apparatus and terminating in an orifice in the  
10 dielectric layer; and  
a vacuum pump connected to the at least one conduit that aspirates air through the  
conduit.
63. A skin treatment device according to claim 62 wherein the pump is a manually operated  
15 pump.
64. A skin treatment device according to claim 62 wherein the pump is an electrically  
powered pump.

**ABSTRACT**

5 A skin gripping apparatus for attracting and holding a region of skin comprising: a conducting layer comprising at least one conductor; a thin dielectric layer bonded to the conducting layer, which dielectric layer has a surface that is placed in contact with the region of skin so that the dielectric layer is between the conducting layer and the region of skin; and an electrical power supply that applies a potential difference between a conductor of the at least one conductor and the skin.



1/17

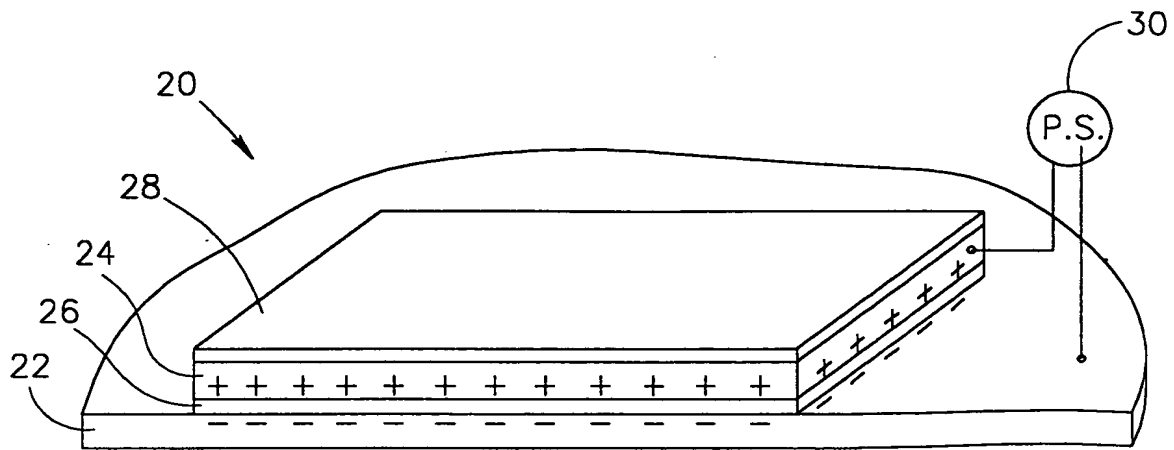


FIG. 1

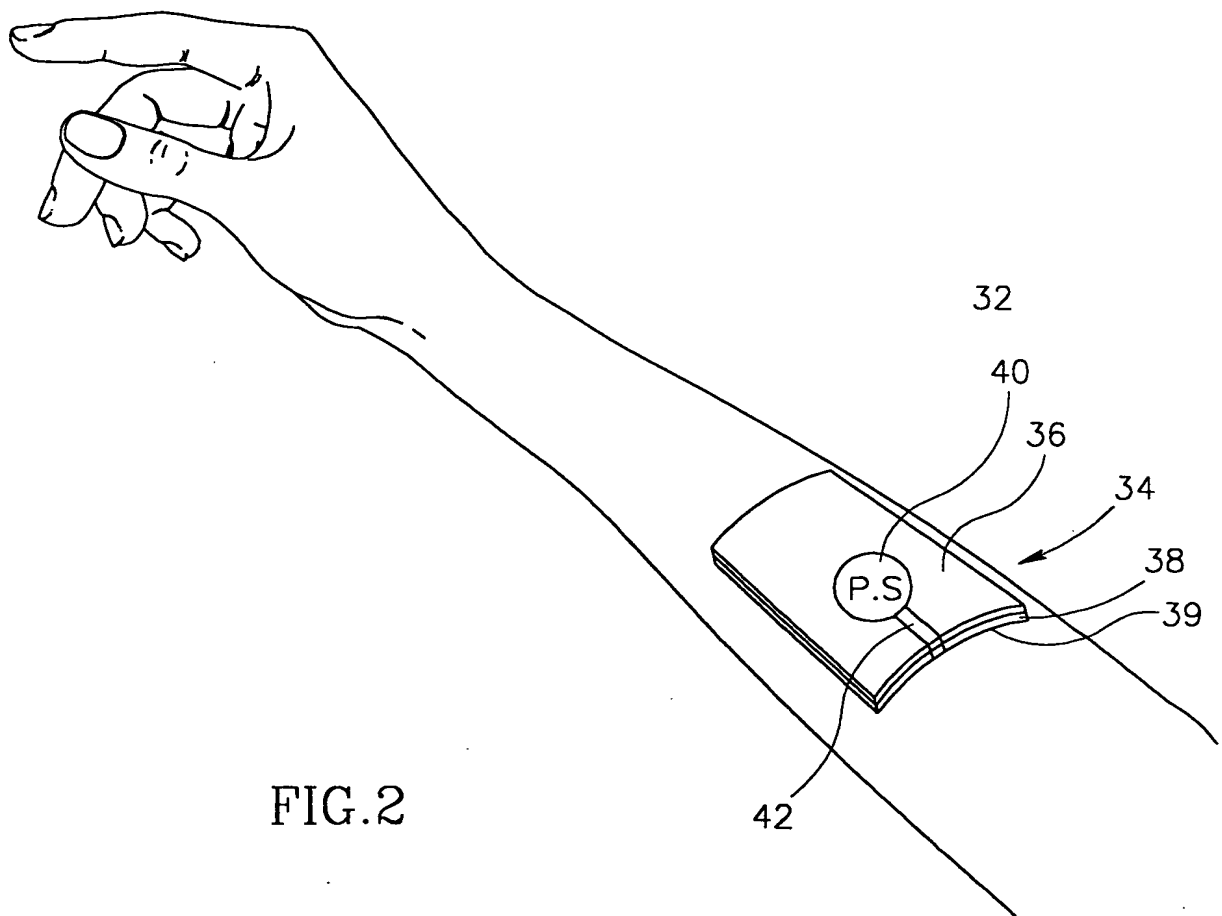
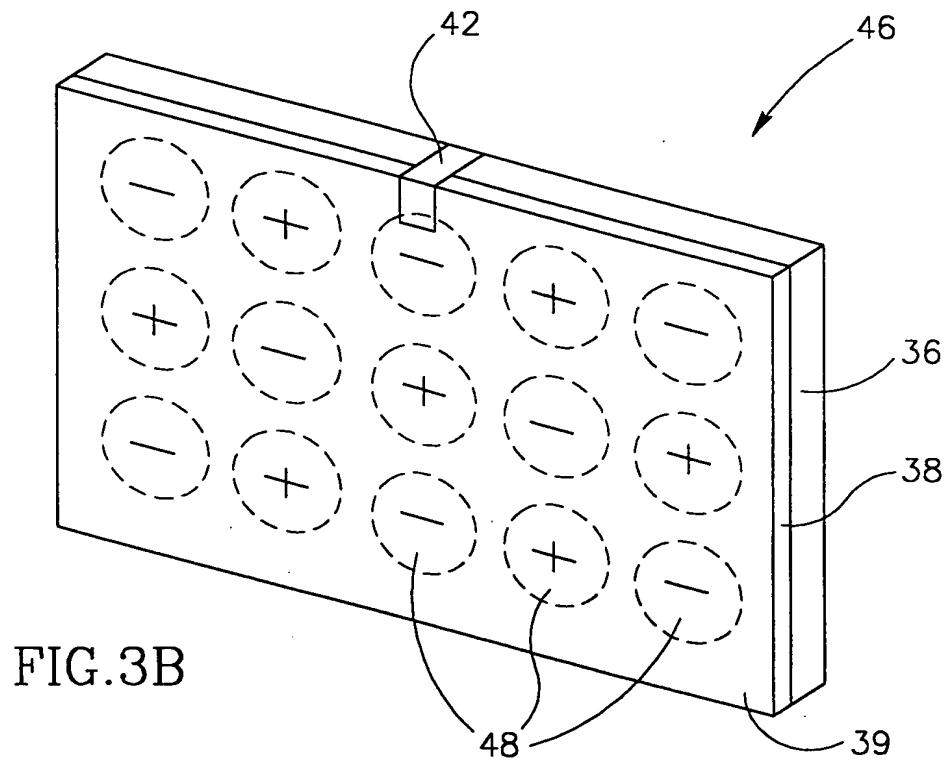
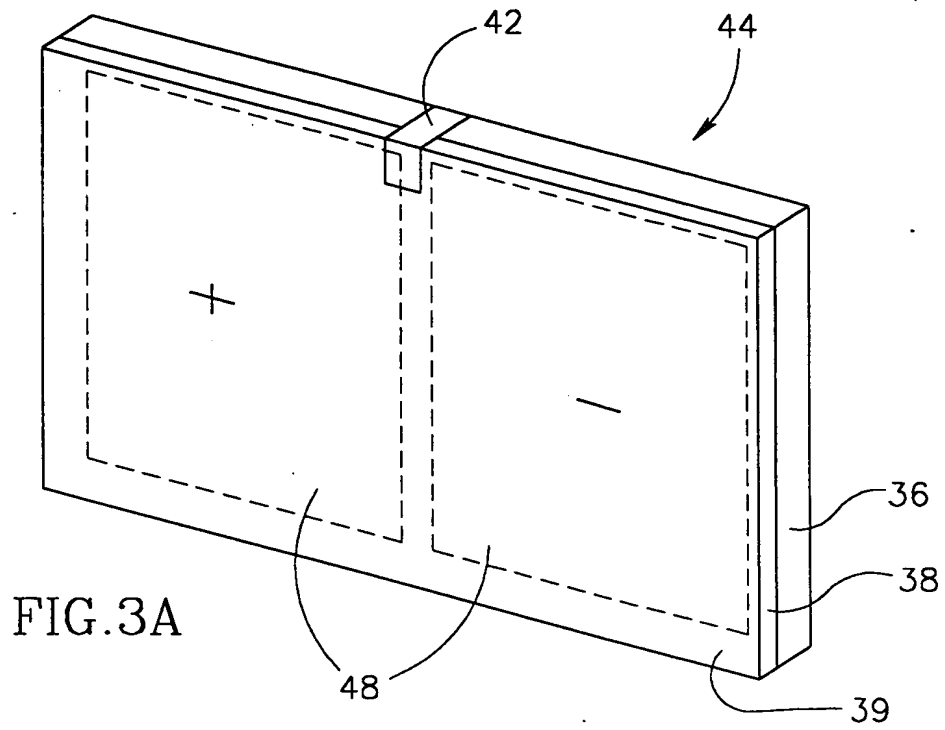


FIG. 2

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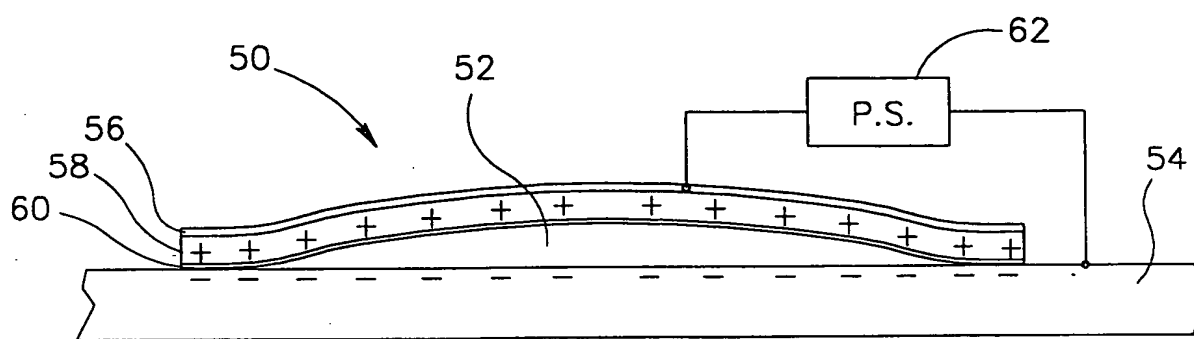


FIG. 4

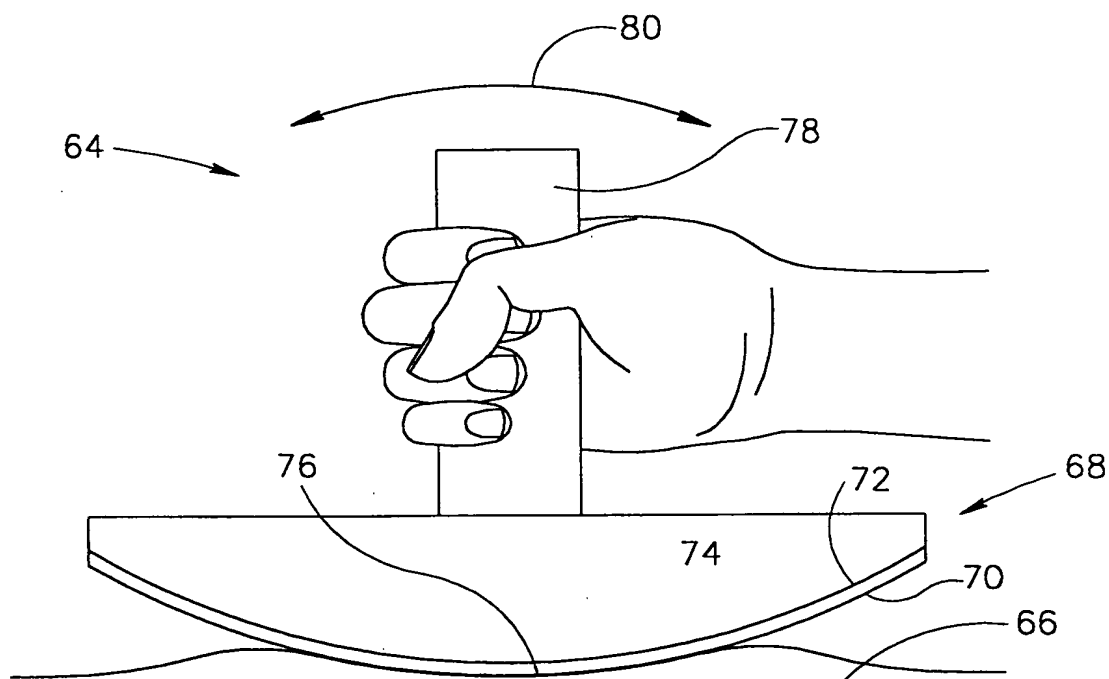


FIG. 5

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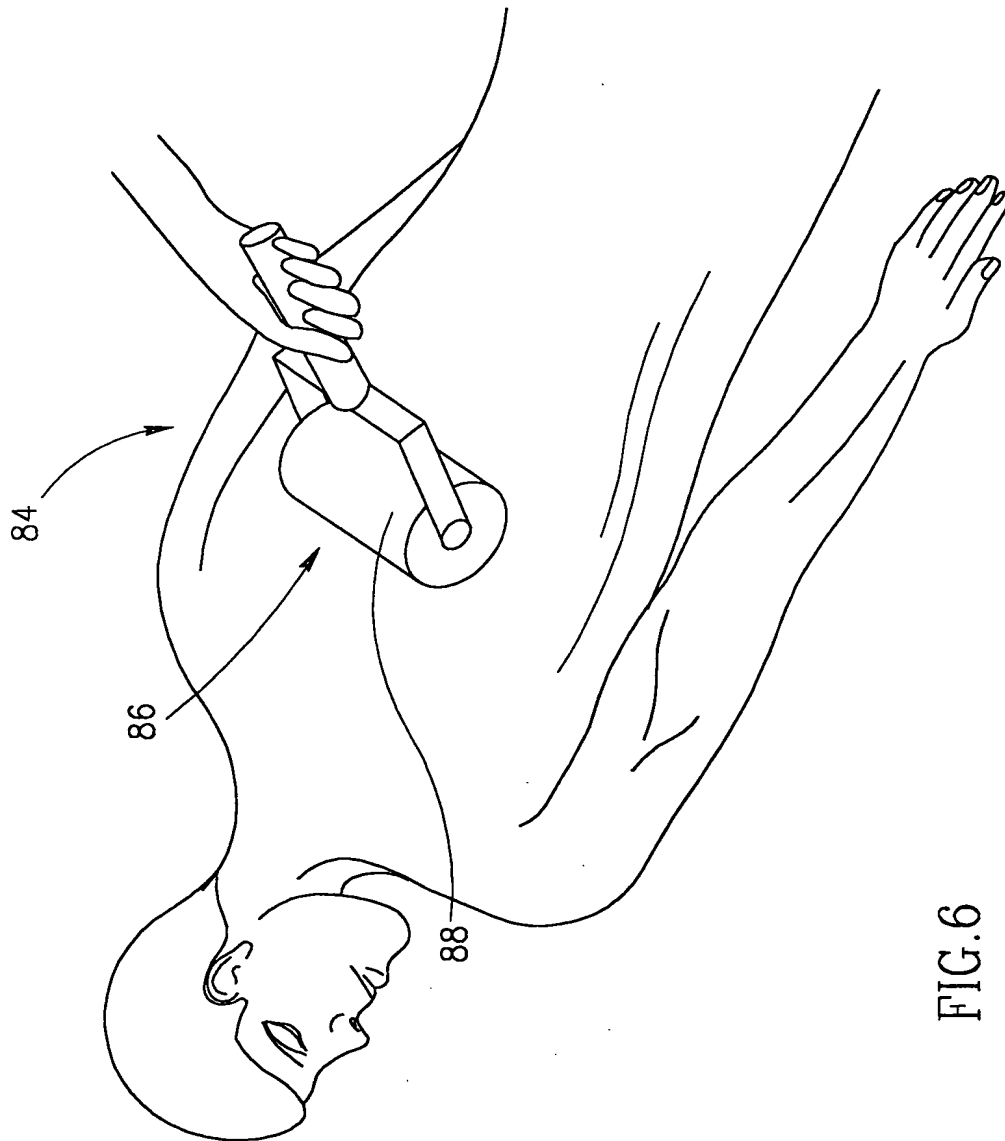


FIG. 6

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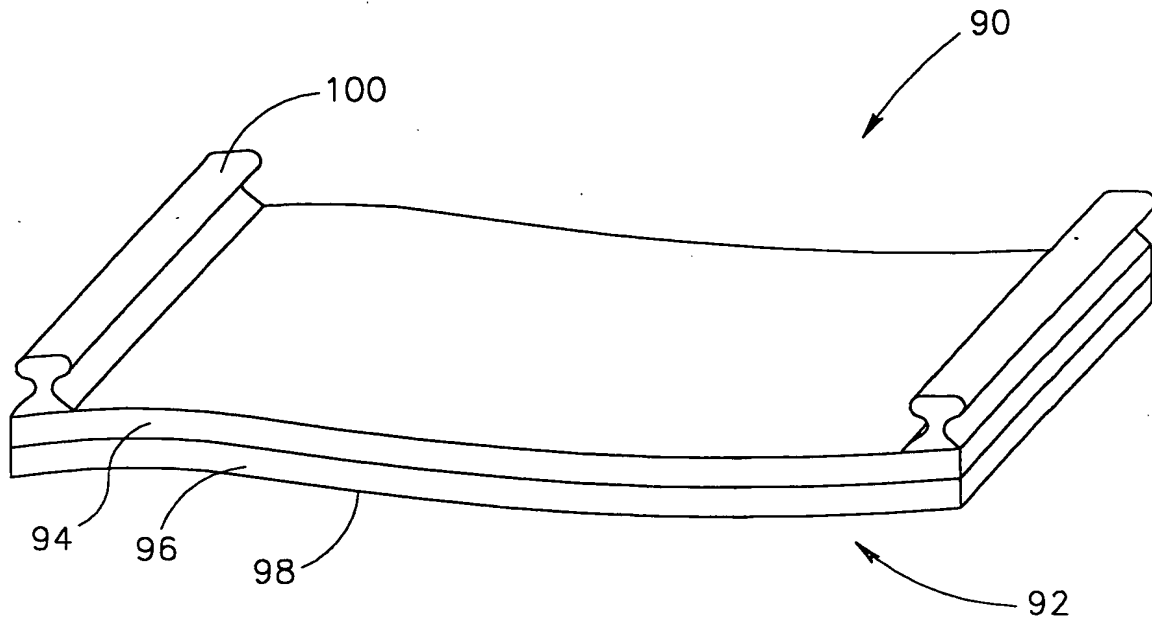


FIG. 7A

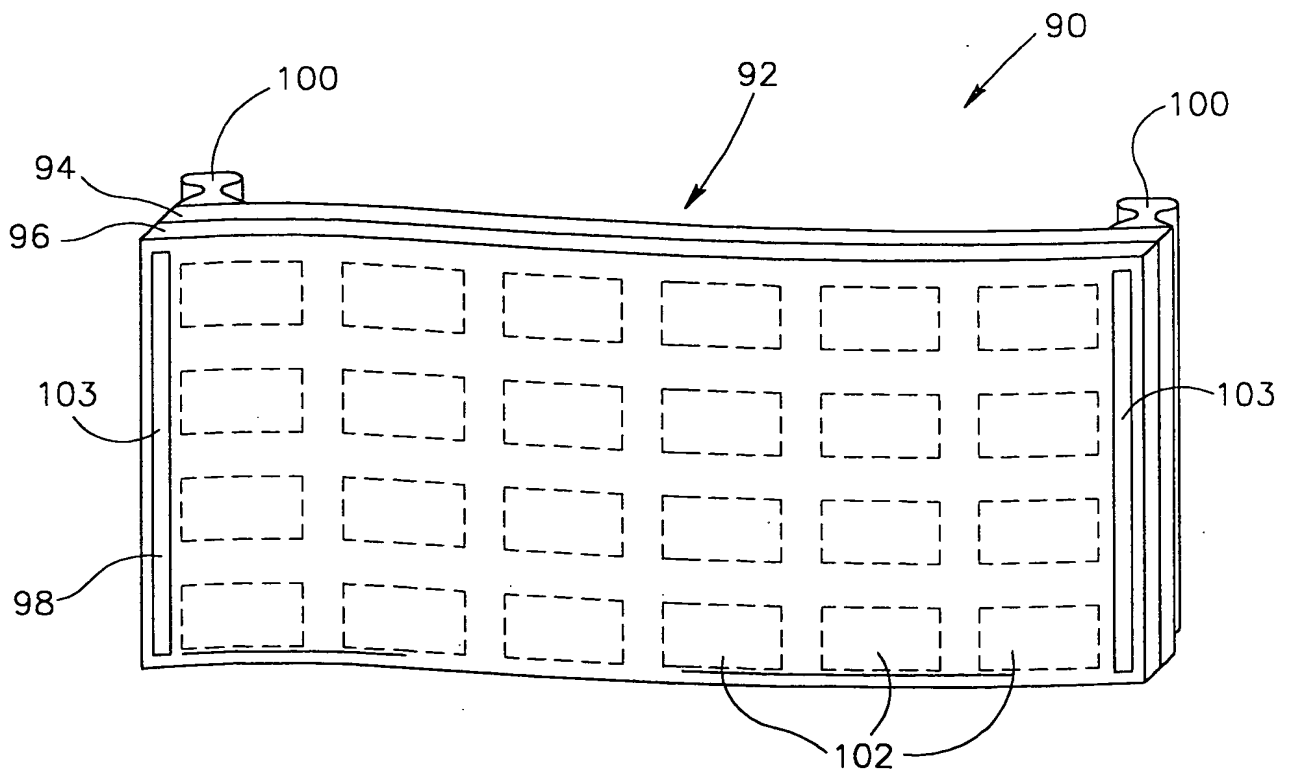


FIG. 7B

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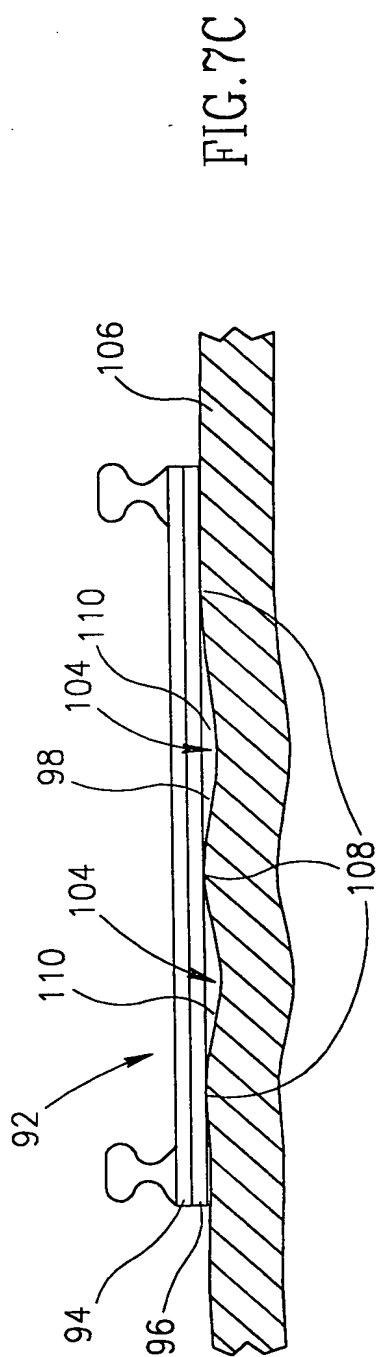


FIG. 7C

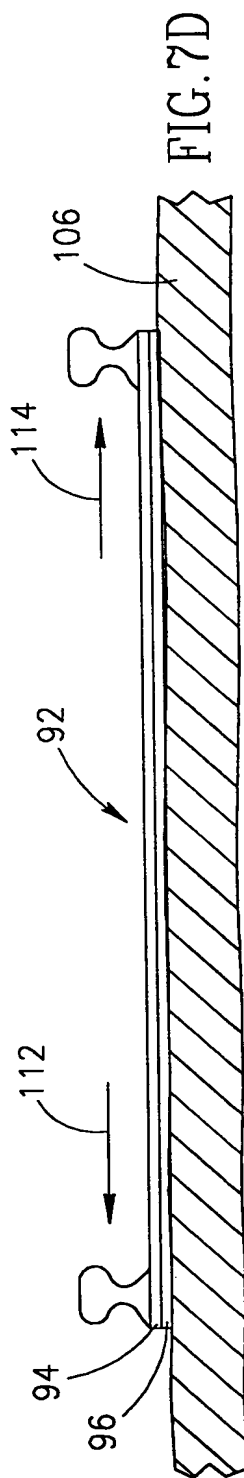


FIG. 7D

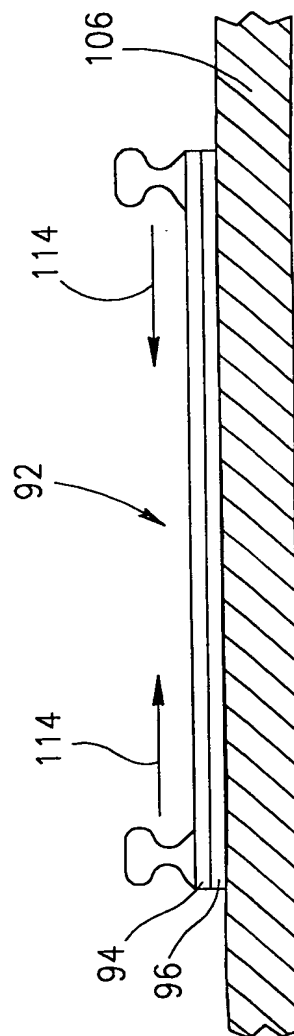


FIG. 7E

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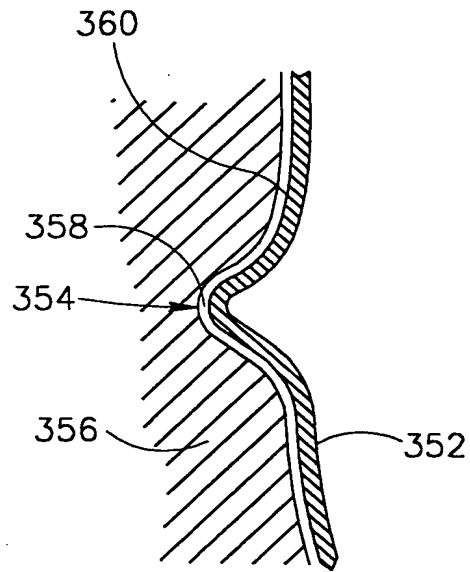


FIG. 8A

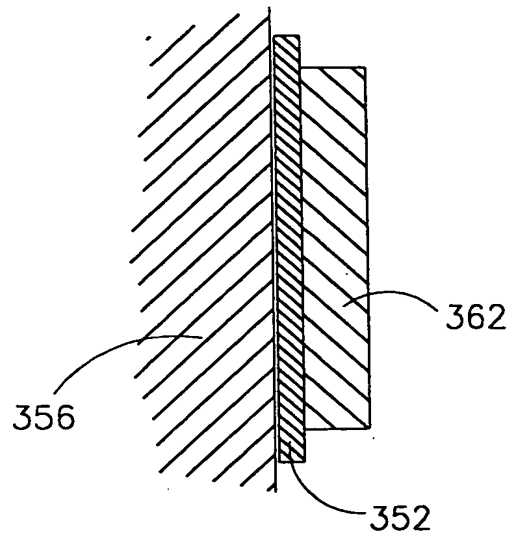


FIG. 8B

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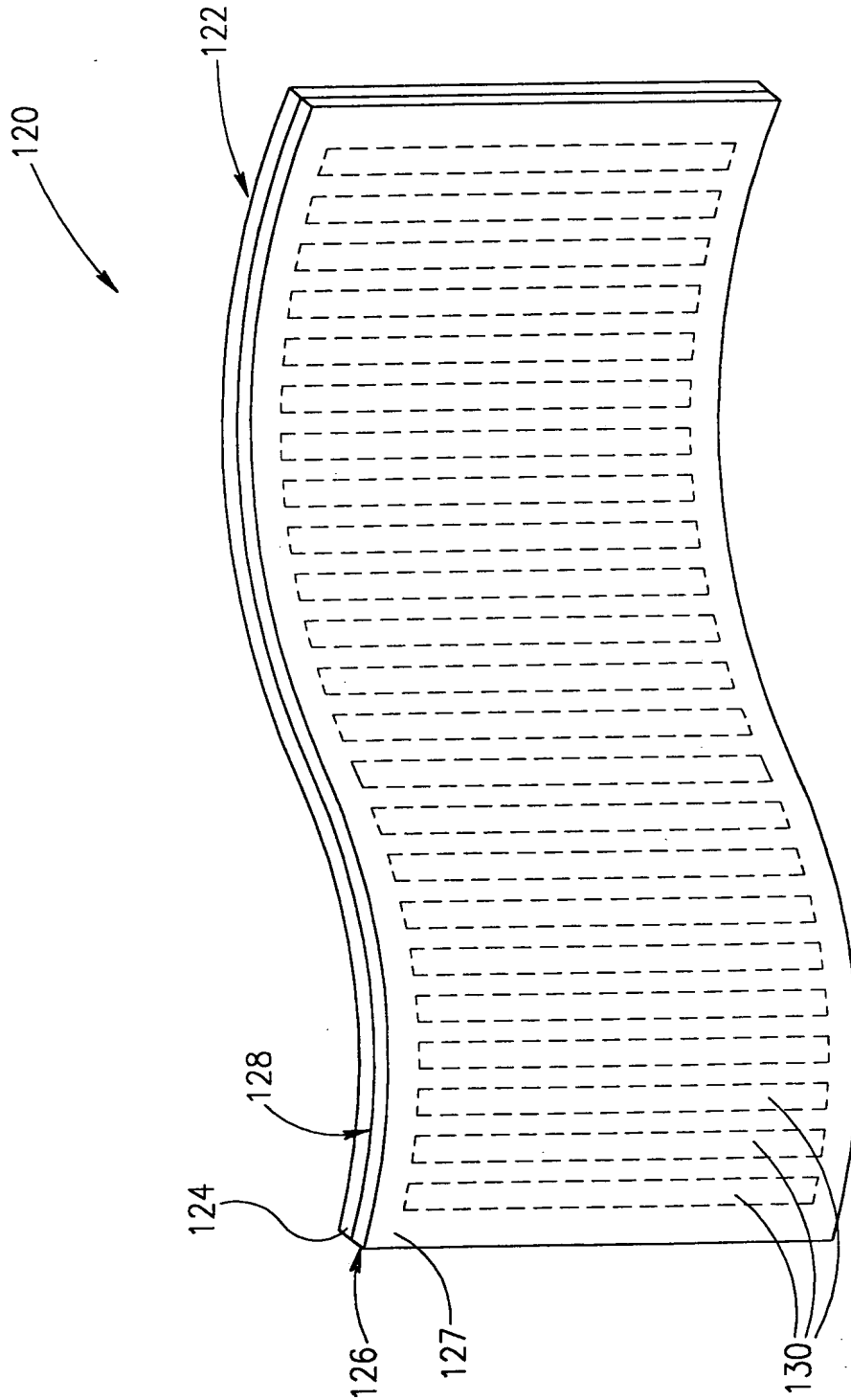


FIG. 9A



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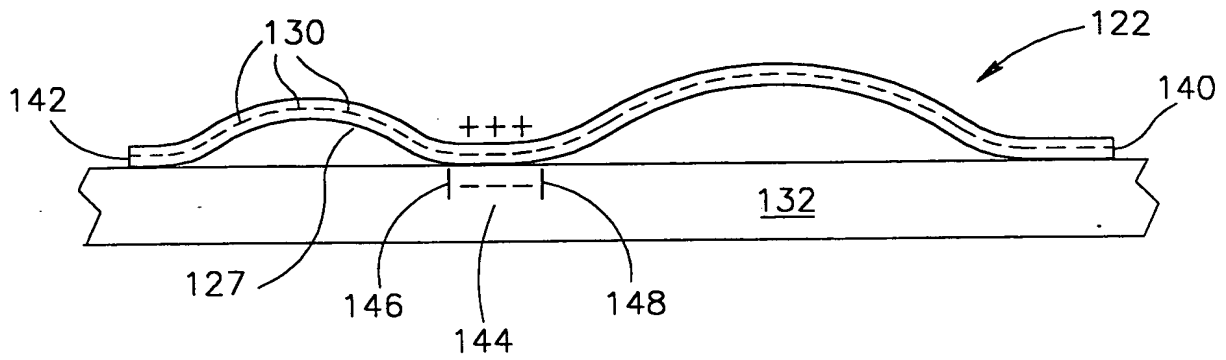


FIG. 9B

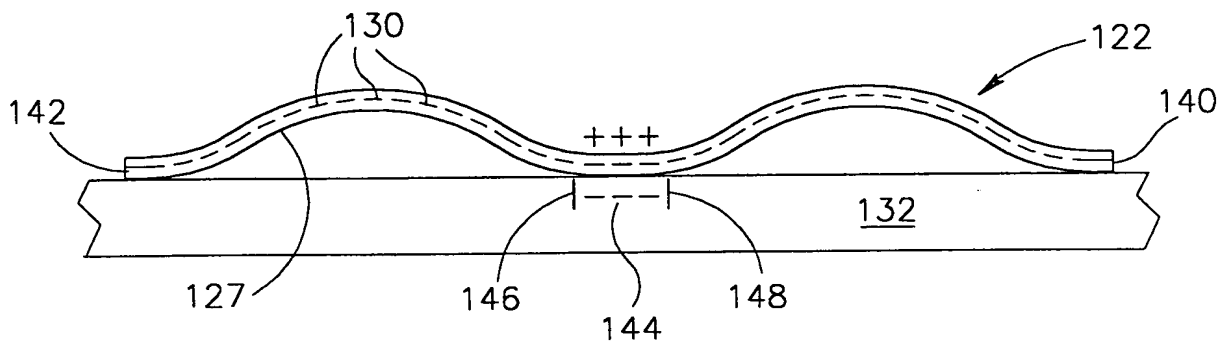


FIG. 9C

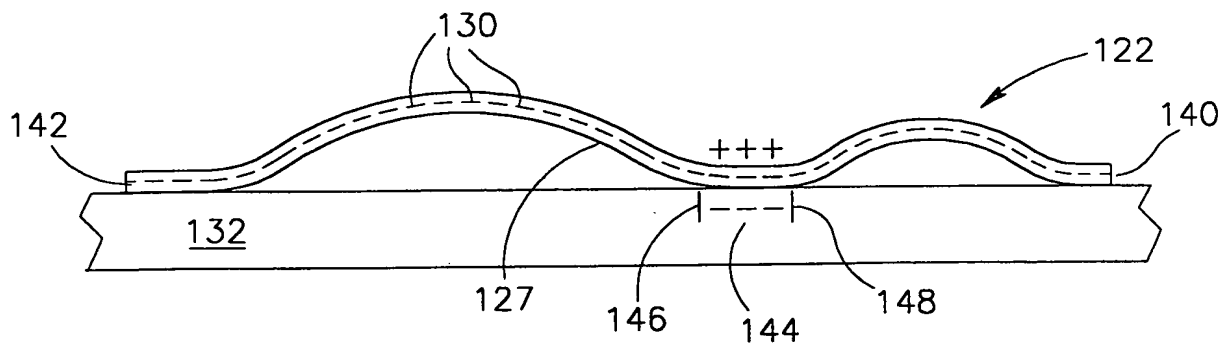


FIG. 9D

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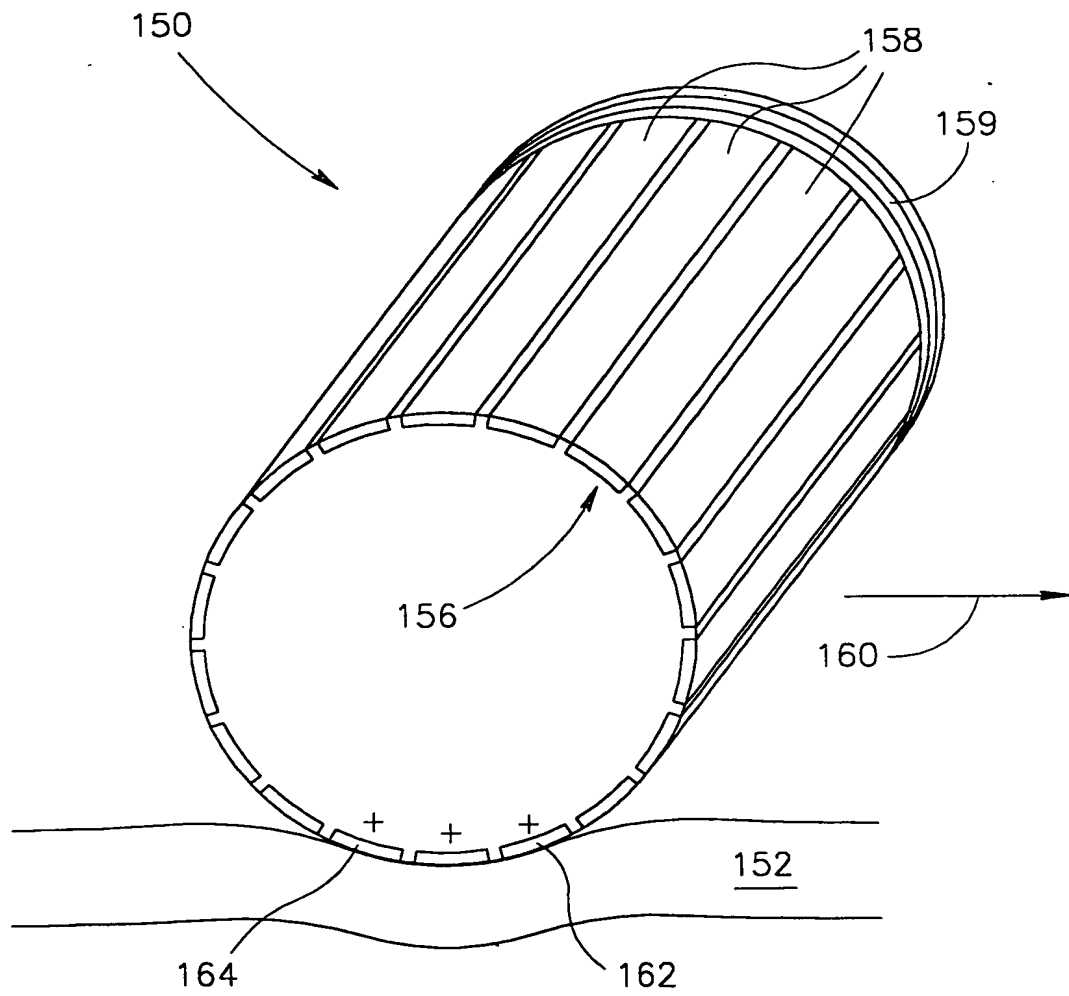


FIG.10

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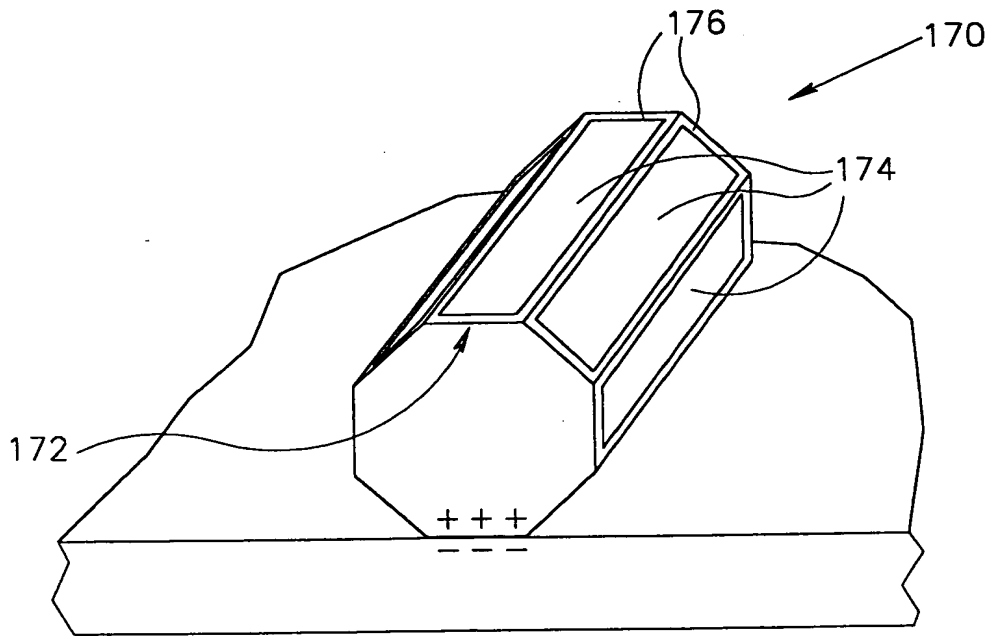


FIG. 11A

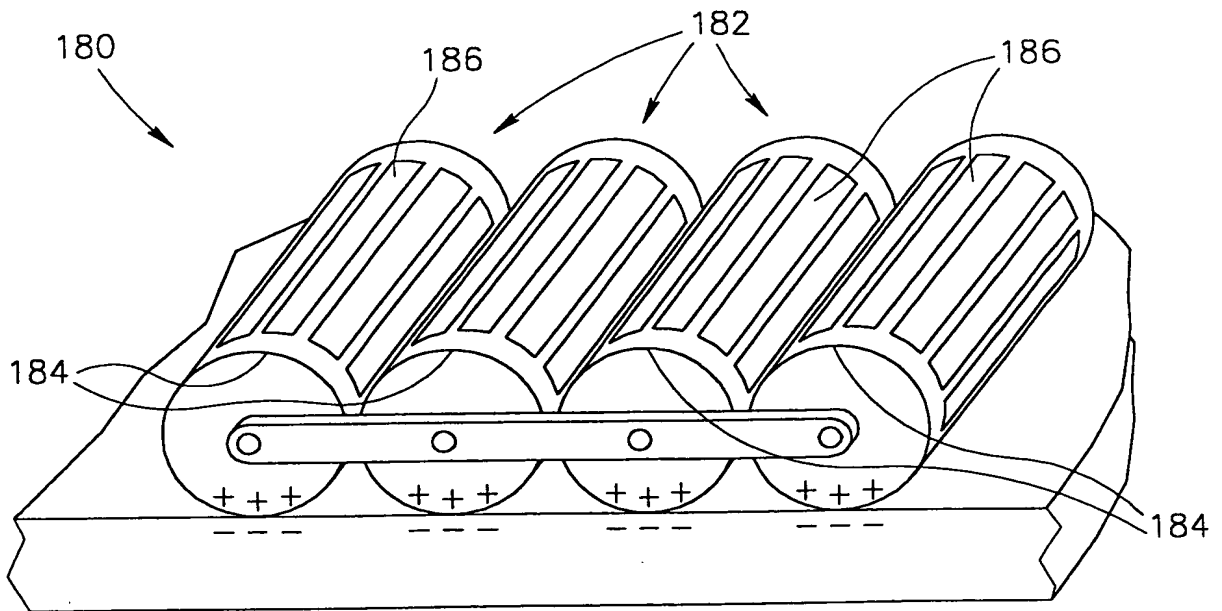


FIG. 11B

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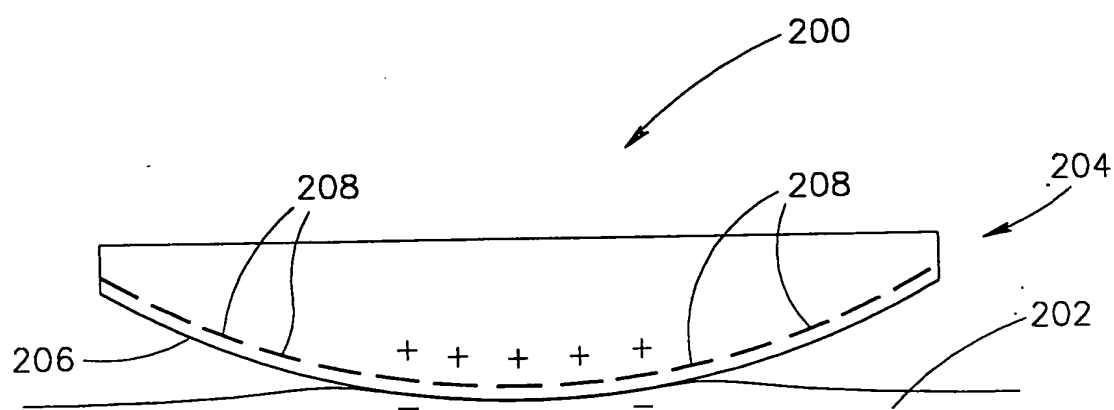


FIG. 12A

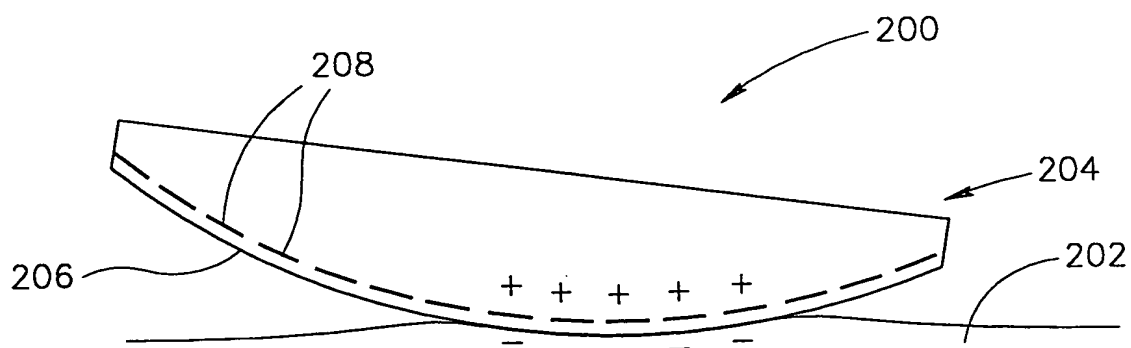


FIG. 12B

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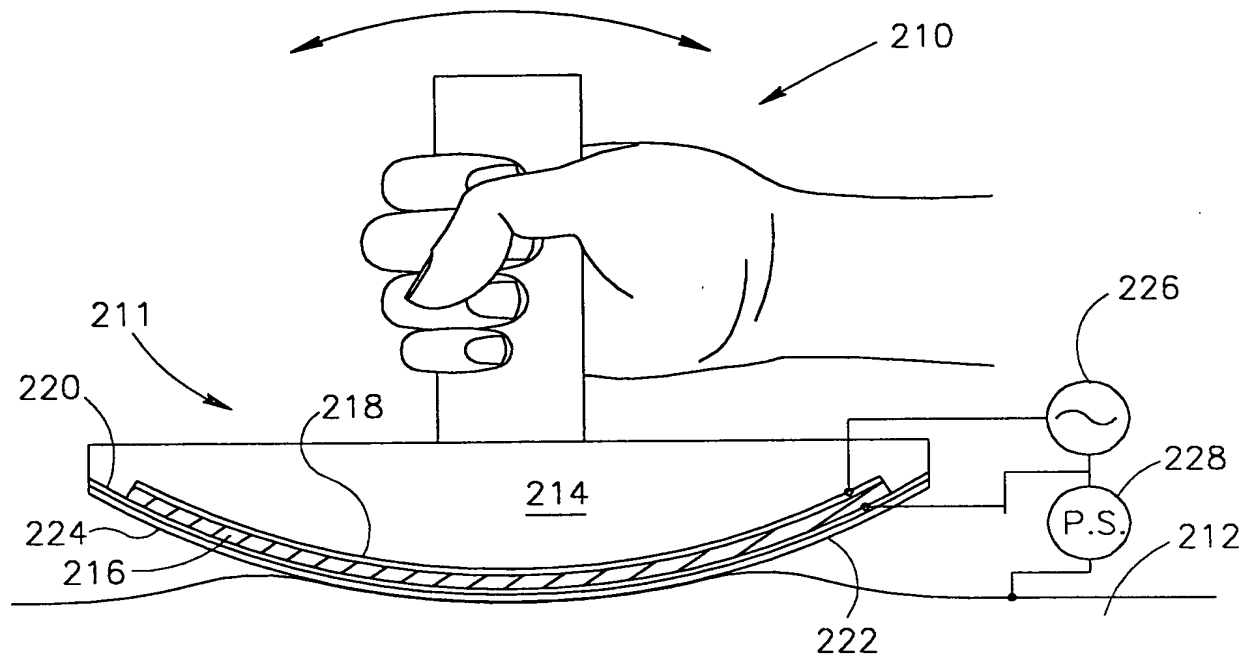


FIG.13

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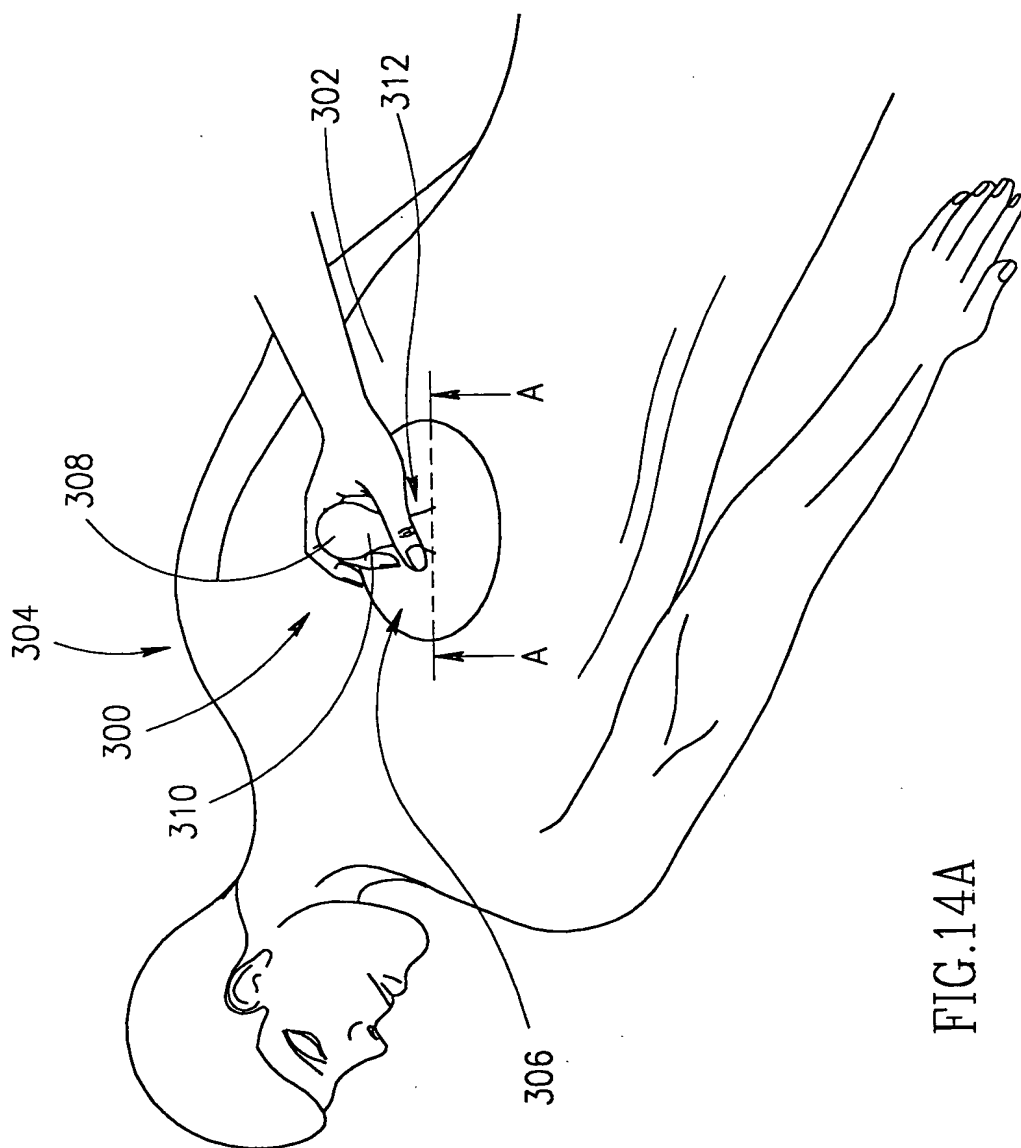


FIG. 14A

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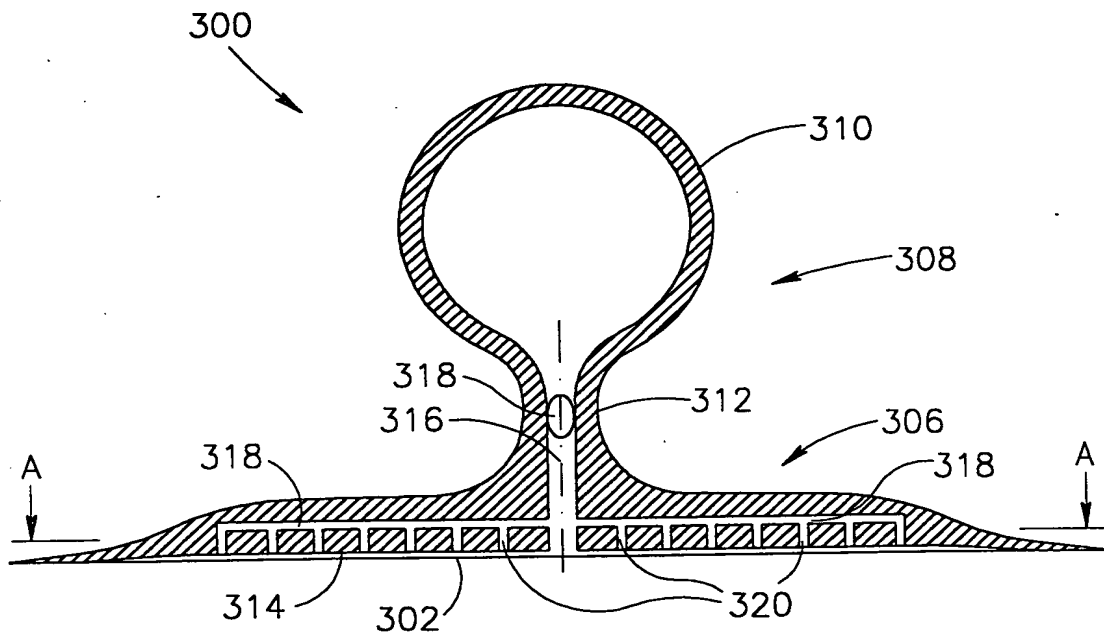


FIG. 14B

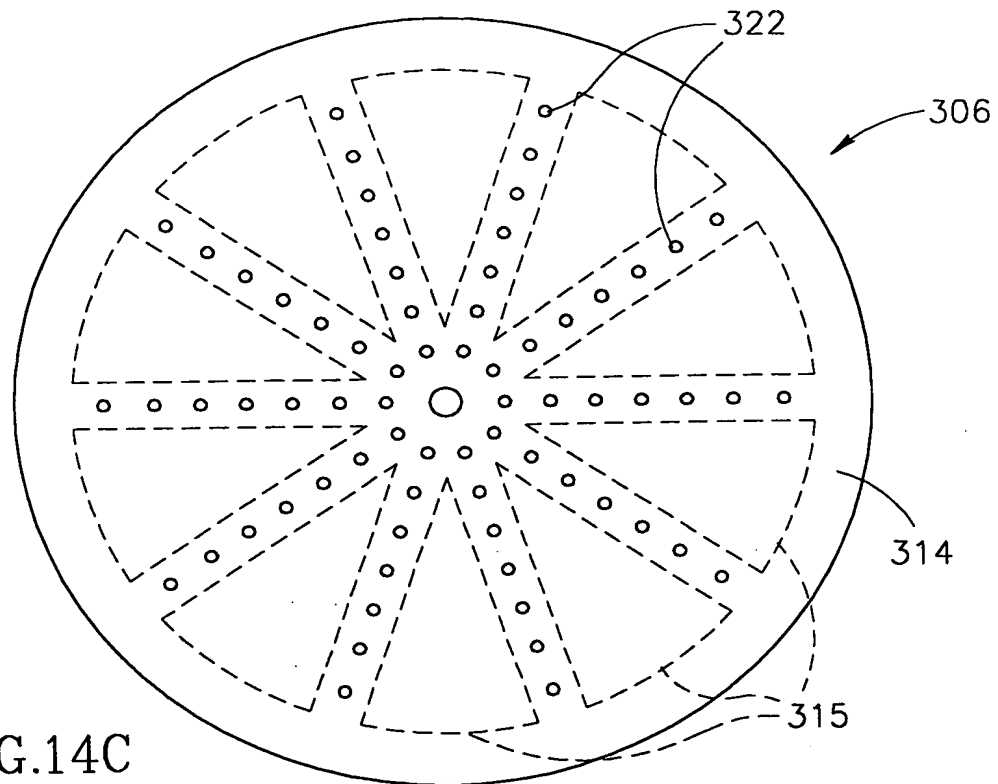


FIG. 14C

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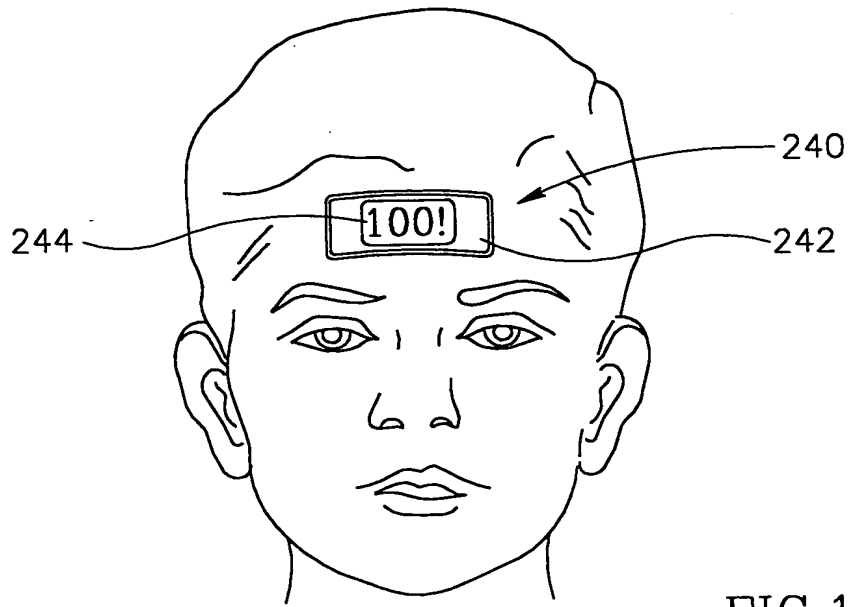


FIG.15

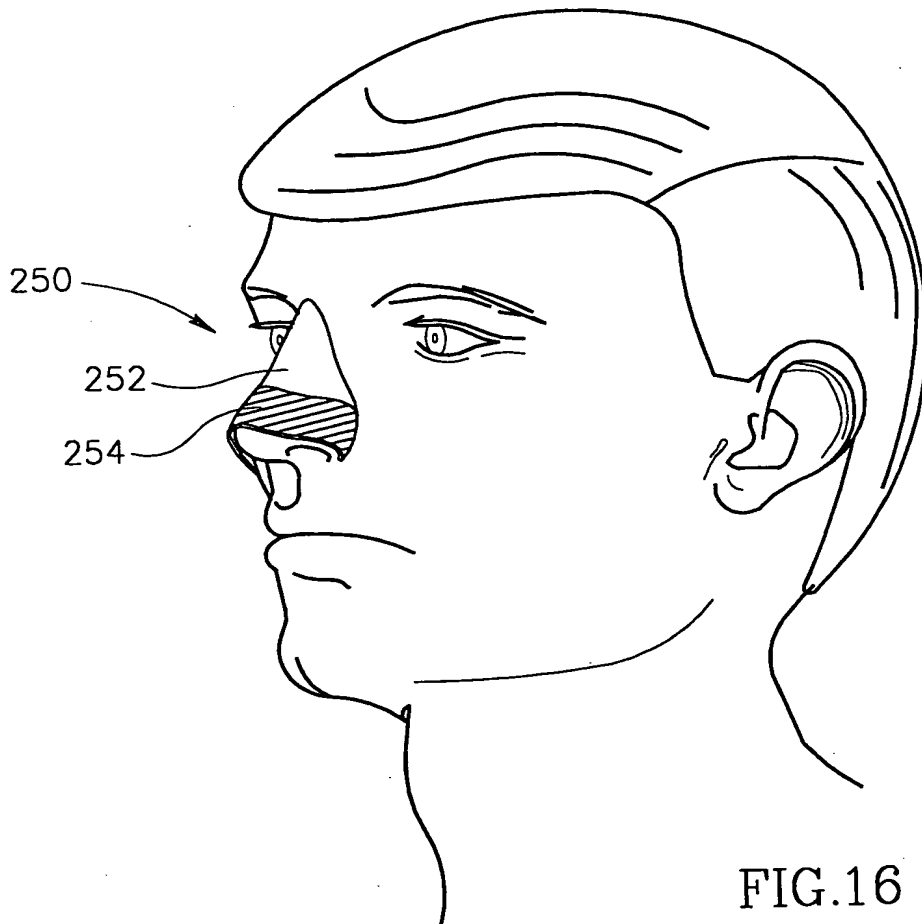


FIG.16



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FIG. 17

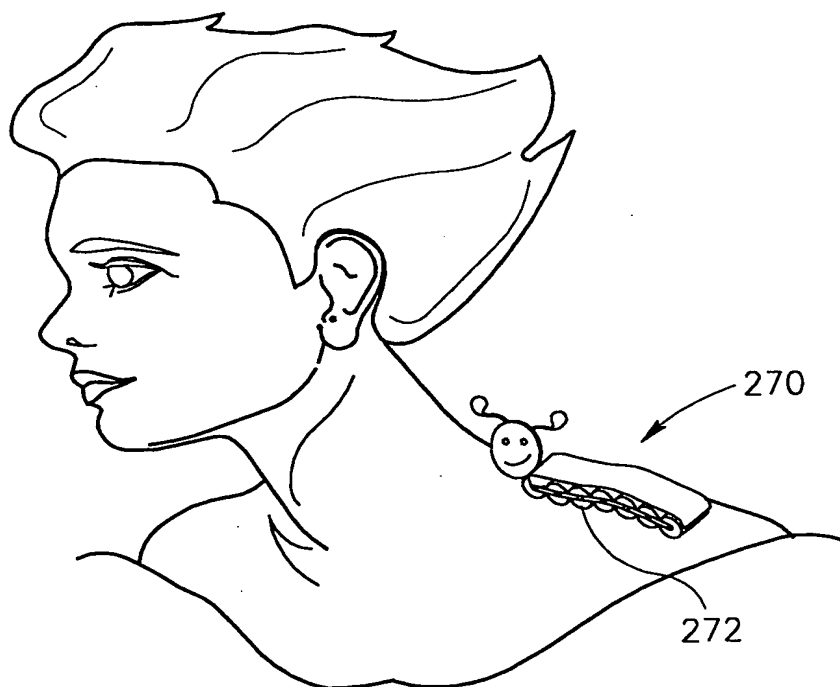


FIG. 18